Aquat. Living Resour. 2023, 36, 2
© G. Carpenter et al., Published by EDP Sciences 2023
https://doi.org/10.1051/alr/2022022

Aquatic Living Resources
Available online at:
www.alr-journal.org

Special Issue - COVID-19 effects on fisheries and aquaculture food systems

RESEARCH ARTICLE OPEN ACCESS

The economic performance of the EU fishing fleet during the COVID-19 pandemic

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Received 31 January 2022 / Accepted 2 December 2022

Handling Editor: Olivier Thebaud

Abstract – The COVID-19 outbreak and subsequent public health interventions have depressed demand and disrupted supply chains for many fishing businesses. This paper provides an analysis of the COVID-19 impacts on the profitability of the EU fishing fleets. Nowcasting techniques were used to estimate the impact of the COVID-19 pandemic on the economic performance for the EU fishing fleet in 2020 and 2021. Our results show that the economic impact of COVID-19 on this sector was smaller than initially expected and overall profits remained positive. This was in part due to low fuel prices that reduced operating costs of fishing, and the early response from governments to support the sector. The results vary by fishing fleet, revealing that small-scale fleets and the fleets in the Mediterranean and Black seas have been more impacted than large-scale fleets and the fleets in the Northeast Atlantic.

Keywords: COVID-19 / fisheries / economic impact / European Union

1 Introduction

The SARS-CoV-2 coronavirus was first identified in December 2019 in Wuhan, China. It spread globally, and the World Health Organization (WHO) declared it a Public Health Emergency of International Concern in January 2020 and a pandemic in March 2020 (COVID-19 pandemic).

In response to the COVID-19 pandemic, many governments imposed a temporal cessation on large parts of their economies to ensure social distancing and reduce the propagation of the virus (Althouse et al., 2020; Hale et al., 2020; White and Hébert-Dufresne, 2020). The direct health effects of COVID-19 and the resulting public health interventions from governments affected economic sectors in multiple ways (Brodeur et al., 2020; Coibion et al., 2020). The seafood production system was no exception and has been seriously disrupted with impacts occurring at multiple stages of the supply chain (FAO, 2020a; Love et al., 2020, 2021).

Despite its designation as an essential service and thus the ability for fishing activity to continue, there was a global reduction in fishing effort and landings during the lockdown period (Korten, 2020). This outcome was partly due to difficulties in implementing sanitary measures (e.g. social distancing of crew members at sea) leading to the cessation of their activity and/or postponing the fishing operations (Pititto et al., 2021) but also due to a disruption and decline in demand for certain types of seafood.

The economic performance of fishing businesses cannot be separated from seafood supply chains. In the hotel, restaurant and catering (HORECA) sector, protective measures led to the total or partial cessation of these activities causing dramatic contractions in seafood demand (van Senten et al., 2020a,b), which may have accentuated the decrease in seafood prices since restaurants pay premium values for seafood, in particular fresh, high quality products (FAO, 2020b,c; Love et al., 2020). Moreover, fresh seafood consumption at home also often decreased as people bought food less often (e.g. once a week) (e.g. Laguna et al., 2020, while Love et al. (2021) show that retail demand for seafood increased significantly in the US) and personal income fell due to shorter working hours and a spike in unemployment (e.g. Forsythe et al., 2020 in the US) – e.g. from 6.5% in February to 7.8% in July 2020 in the EU (Eurostat, 2021a)[1].

The cessation of non-essential economic activities affected the global fisheries sector, with particular emphasis on some small-scale coastal fleets (SSCF) (e.g. Villasante et al., 2021). In the US, recent analysis has revealed that COVID-19 generated substantial declines in fresh seafood catches, imports and exports, while frozen seafood products were generally less affected (White et al., 2021).

In the summer of 2020, COVID-19 cases decreased, and the strict distancing rules were relaxed; but a second wave came in autumn 2020 and countries again imposed protective measures, although generally more lenient than those imposed during the first wave. A similar situation persisted throughout most of 2021.

In the European Union (EU), there have been multiple 'waves' of COVID-19 in 2020 and 2021. The first wave resulted in many EU countries imposing, in March 2020, a nation-wide closure of all economic activities with the exception of those considered essential to livelihoods[2]. The fishing sector, as a food provider, was included as an essential service. Due to this disruption, a deterioration in the economic performance of the EU fishing fleet was expected for the year 2020, largely in line with the European Commission's

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[1] With seafood being a very perishable product, and often being a luxury product.

[2] The restrictions, their duration and enforcement varied between countries and sectors, even if they had many things in common. Southern countries imposed some of the longest and most stringent lockdowns (e.g. Spain and Italy); while in northern countries, lockdown measures varied more. For example, Sweden did not impose a lockdown-like mandate, but put the responsibility on people to follow social-distancing measures and fewer restrictions (e.g. on restaurants).

Table 1. Main indicators of the EU small-scale coastal fleet (SSCF), large-scale fleet (LSF) and distant-water fleet (DWF) in the Northeast Atlantic Ocean (NAO), Mediterranean and Black seas (MBS) and other fishing regions (OFR) for 2019.

Variable	Unit	NAO		MBS		OFR			TOTAL
		SSCF	LSF	SSCF	LSF	SSCF	LSF	DWF	
Number of vessels	Thousand	13.7	7.0	27.6	7.1	1.5	0.1	0.3	57.2
Live weight of landings	Thousand tonnes	146.9	2,748.0	64.8	362.2	8.1	3.5	698.4	4,032.0
Value of landings	Million EUR	477.4	2,954.8	470.1	1,300.1	38.9	7.3	949.4	6,197.8
Employment: Engaged crew	Thousand	23.0	32.6	36.9	27.5	2.7	0.3	6.5	129.5
Employment: Full Time Equivalent	Thousand	11.4	26.9	23.3	21.6	0.8	0.1	8.1	92.3
Gross Value Added	Million EUR	315.5	1,583.0	335.2	801.2	27.9	1.2	300.9	3,364.9
Gross profit	Million EUR	91.8	539.5	116.9	409.3	6.7	–1.7	85.9	1,248.4
Landings per vessel	Thousand EUR	32.9	426.0	16.6	188.6	33.7	188.5	3,775.4	109.5
Gross profit per vessel	Thousand EUR	6.7	77.1	4.2	57.8	4.4	–28.3	331.8	21.8
GVA per FTE	Thousand EUR	27.6	58.8	14.4	37.0	36.1	8.9	37.2	36.5

Source: own elaboration from the 2021 AER (STECF, 2021).

estimated 8% reduction in Gross Domestic Product (GDP) for the whole EU-27 economy (European Commission, 2020).

As official cost and earnings data on the EU fishing fleet is published with almost a two-year time lag, meaning that 2020 official economic performance information will only be available around mid-2022, nowcasting techniques were used in the Annual Economic Report of the EU fishing fleet (AER) (STECF, 2021) to estimate the impact of the COVID-19 pandemic on the economic performance for the EU fishing fleet.

2 The EU fishing fleet in numbers

In 2019, the EU fishing fleet had 57,236 active vessels. The fleet landed 4.03 million tonnes of seafood with a value of €6.3 billion[3]. Direct employment generated by the sector amounted to 129,540 fishers, corresponding to 92,298 FTEs. The amount of gross value added (GVA) and gross profit generated by the EU fishing fleet was €3.4 billion and €1.25 billion, respectively (see Tab. 1).

The fishing fleet operating predominantly in the North Atlantic Ocean (NAO[4]) comprises some 36% of the active EU fleet in number of vessels, employs 43% of the fishers and contributes 72% by weight and 55% by value of the total EU landings. The EU Mediterranean and Black seas fleets (MBS, FAO fishing area 37) represents 61% of the active EU fleet (number of vessels), employs 50% of the fishers and contributes 11% by weight and 29% by value of the total EU landings. The remaining vessels operate predominately in the territorial waters of several EU Outermost Regions and/or fishing grounds outside EU waters in Areas Beyond National Jurisdiction (ABNJ) as well as within the EEZ of third countries regulated under the framework of EU Sustainable Fisheries Partnership Agreements (SFPAs). Fleets operating in these areas, collectively termed "Other Fishing Regions" (OFR), represent 3% of the total EU active fleet, 7% of the engaged crew, 18% in landings and 17% to the value of the total EU fleet.

This study focuses on the EU fleets in the NAO and MBS fishing regions. The economic impact of the COVID-19 pandemic is also estimated by the scale of fishing activity, namely for the small-scale coastal (SSCF) and large-scale (LSF) fisheries.

The SSCF is defined by the European Maritime and Fisheries Fund Regulation as fishing carried out by fishing vessels under 12 metres using static gears (EU, 2014). The large-scale fleet (LSF) segment includes all vessels over 12 metres using static gears and all vessels using towed gears operating predominantly in EU waters. The EU distant-water fleet (DWF) includes EU registered vessels over 24 metres operating predominately in OFR (STECF, 2021). Fleets operating in OFR are excluded from the analysis due in part to data limitations often related to confidentiality reasons as well as the added complexity in estimating the drivers behind fishing activity and performance indicators for these vessels.

3 Methodology

Under the EU Data Collection Framework (DCF-EC, 2017), EU countries are required to submit annually fishing activity and economic data on their fishing fleets. These data are used to produce the AER (STECF, 2021).

For the 2021 AER (STECF, 2021), full economic datasets were submitted for 2019 (year *t*–2). Preliminary data on the number of vessels, fishing effort and landings for 2020 (year *t*–1) are usually also made available. However, given the two-year time lag in the economic data, relevant variables are estimated for 2020 (year *t*–1) and 2021 (year *t*) using a nowcasting approach and the Bio-economic Model of European Fleets (BEMEF) (Nielsen et al., 2018; STECF, 2017, 2021) in order to obtain a more current analysis on the performance of the EU fleet. Robust nowcasted data are paramount to policy-making, especially for responding to an immediate and current crisis, as was and is the case of the COVID-19 pandemic.

[3] Economic values are expressed in 2015 real terms, using the Harmonised Index of Consumer Prices from Eurostat (2021b), which uses the consumption in 2015 as its base year (2015=100).

[4] NAO comprises the Baltic Sea, North Sea, Eastern Arctic, NAFO; Extended North-Western waters (ICES areas V, VI and VII) and Southern Western waters.

The nowcasting procedure is based on the most recent available sources of observed and anticipated drivers (e.g. changes in sales volumes, fish prices, and fuel prices) compared to the economic performance in 2019. In the nowcasting methodology, several key drivers of fleet economic performance (for year t and when needed for year *t*–1) that are frequently updated and publicly reported are applied to the most recent economic performance estimates (year *t*–1 or year *t*–2, where necessary). For example, current year data on fleet capacity (e.g. number of vessels) are available from the EU Fleet Register (European Commission, 2021); fuel prices and fish prices from the European Market Observatory for Fisheries and Aquaculture (EUMOFA, 2021); Total Allowable Catches (TACs) for commercial species from the EU Council regulations; inflation in the form of the Harmonised Index of Consumer Prices from Eurostat (Eurostat, 2021b); interest rates from the European Central Bank (ECB, 2021), and fish stock biomass from the International Council for Exploration of the Seas (ICES, 2021).

To estimate fleet economic performance, economic variables are linked to a small number of explanatory variables based on their historical correlation[5]. This approach has been used in the AER (STECF, several years) and follows standard practice in nowcasting by integrating known data that has a proven relationship with the dependent, unreported variables (see Appendix A for further details on the methodology).

For the nowcasting methodology, a variable *A* in year *t*–1 is estimated at the fleet segment level by the same variable *A* in year *t*–2 and the change variable *B* between year *t*–2 and year *t*–1, when the value for variable *B* in year *t*–1 is known. Thus, the following general formulation is used:

$$A_{t-1} = A_{t-2}\frac{B_{t-1}}{B_{t-2}}. \quad (1)$$

For example, repair and maintenance costs in year *t*–1 is estimated as the repair and maintenance costs in year *t*–2 multiplied by the relative change in the number of vessels between year *t*–2 and *t*–1, which was reported though the EU fleet register.

Using this methodology, economic performance in 2020 cannot simply be compared to 2019 to assess the impact of COVID-19. Economic performance in 2020 was obtained by applying the observed and anticipated drivers and variables; in this case, COVID-19 is an important driver, but not the only one considered (e.g. changes in quotas). Thus, it is very challenging to distinguish which impact is directly related to the COVID-19 pandemic and to what extent other drivers have been impacted by COVID-19 (e.g. low fuel prices).

COVID-19 financial support programmes were not directly incorporated into the economic performance estimates since support has often been directed to fishers, for example through temporary lay-off schemes. Hence, this support has not a direct link to vessels' profits and fleet performances. Furthermore, information on these programmes is scarce and many programmes were 'tie-up' schemes (rather than 'top-up' schemes) so total pay-out is expected to be small compared to overall fleet performance[6]. This exclusion may be an important caveat to the nowcasts especially where these programmes are large and/or have a high level of uptake (Hamza et al., 2017).

The indicators used to estimate the economic performance are Gross Value Added (GVA) and Gross profit and are calculated, following the AER methodology (e.g. STECF 2020, 2021):

$$\begin{aligned} \text{GVA} &= \text{Income from landings} + \text{other income} \\ &- \text{energy costs} - \text{repair and maintenance costs} \\ &- \text{other variable costs} - \text{other non variable costs} \end{aligned} \quad (1a)$$

$$\begin{aligned} \text{Gross profit} &= \text{Income from landings} \\ &+ \text{other income} - \text{crew costs} - \text{value of unpaid labour} \\ &- \text{energy costs} - \text{repair and maintenance costs} \\ &- \text{other variable costs} - \text{other non variable costs.} \end{aligned} \quad (1b)$$

4 Results

Our nowcast results indicate an overall decrease of 1% in landed weight and 4% in landed value, while fish prices decreased by 3% in 2020 compared to 2019 for the EU fishing fleet. When accounting for the costs of production[7], results indicate a 1% increase in GVA and a 9% increase in gross profit, despite the reduction in landings. In contrast, estimates for 2021 show a decrease from 2020 for all economic variables, including a 3% decrease in the value of landings and a 17% decrease in gross profit. Results, however, vary significantly by country and fishery (Tabs. 2 and 3).

Our estimates also suggest that landings for the small-scale coastal fleet (SSCF) decreased significantly in 2020 compared to 2019, while landings for the large-scale fleet (LSF) reduced both in terms of weight and value (see Tab. 2, and the discussion section for an analysis of potential explanations). In terms of economic returns, GVA and gross profits for the SSCF fell by 4 and 5% from 2019 to 2020. Conversely, the economic performance of the LSF improved 3% and 11%, respectively, indicating that this segment was able to mitigate some of the negative impacts on the overall performance of the EU fleet. Estimates for 2021 show a decrease in landings and profitability for both the SSCF and the LSF compared to 2019 and 2020. These results are fairly consistent with those experienced in the US (NMFS, 2021).

5 Discussion

While the COVID-19 pandemic and subsequent public health interventions had a significant effect on some EU fishing fleets, nonetheless it is estimated that the fleet as a whole continues to be profitable despite a decrease in landings.

The change in economic performance of the EU's fishing fleet in 2020 is driven by several factors. As can be seen on Table 2, there has been a slight decrease in landings weight and

[5] The main difference between the NAO and MBS nowcast estimates is that changes in the TACs is an important explanatory variable for the activity and performance of the NAO fleets, while in the MBS fisheries TACs are only applied for bluefin tuna and swordfish.

[6] The economic performance is estimated without considering direct support, i.e., subsidies.

[7] There is an important reduction in the production costs, especially due to the decrease in fuel costs. According to 2021 AER data, the average fuel price decreased 21%, from 0.51 €/litre in 2019 to 0.40 €/litre in 2020, see Table 2.

Table 2. Economic performance of the EU-27 fleet 2018–21 (2020 & 2021 are nowcast estimates) by fishing activity (scale of fishing operation).

Variable	Unit	SSCF					LSF				
		2018	2019	2020	2021	Change 2019–20	2018	2019	2020	2021	Change 2019–20
Live weight of landings	Thousand tonnes	220.5	211.7	201.6	197.1	–5%	3,514.1	3,110.2	3,075.3	2,919.4	–1%
Value of landings	Million EUR	1,015.9	947.4	911.2	911.5	–4%	4,657.5	4,316.9	4,136.2	3,983.7	–4%
Energy consumption	Million litres	146.8	143.0	134.1	133.0	–6%	1,496.2	1,490.6	1,447.6	1,391.5	–3%
Employment: FTE	Number	39,850	34,746	33,630	33,424	–3%	49,790	48,552	46,576	45,294	–4%
GVA	Million EUR	708.1	650.7	626.8	600.1	–4%	2,656.0	2,384.2	2,450.3	2,209.2	3%
Gross profit	Million EUR	227.5	208.6	198.8	177.0	–5%	1,122.9	948.8	1,057.6	867.2	11%
Fish Price	EUR/kg	4.61	4.47	4.52	4.63	1%	1.33	1.39	1.34	1.36	–3%
Fuel Price	EUR/litre	0.72	0.68	0.67	0.85	0%	0.51	0.49	0.38	0.47	–23%
Landing weight per litres of fuel	Kg/litre	1.50	1.48	1.50	1.48	2%	2.35	2.09	2.12	2.10	2%
Landing value per value of fuel	Number	9.6	9.8	10.1	8.0	3%	6.1	5.9	7.6	6.1	29%

Source: own elaboration from STECF's 2021 AER.

fish prices, but the economic performance has not been so much impacted because costs have decreased (mainly fuel costs) since fishing effort was reduced[8].

Results, reported in Tables 2 and 3, indicate that the fishing sector fared better than the European economy as a whole; the European Commission estimate that the Gross Domestic Product of the EU-27 fell by 8% in 2020 (European Commission, 2020).

Results, however, vary significantly by country and fishery (see also European Commission et al., 2021). The EU's Mediterranean and Black Sea fleet along with the SSCF fleets all recorded a weaker economic performance in 2020 compared to 2019 whereas the economic performance of the LSF and the Northeast Atlantic fleet improved during the same period. Our estimates suggest, overall, a 1% increase in GVA from 2019 to 2020, with the SSCF experiencing a 4% decrease and the LSF a 3% increase. At the fleet level, the GVA of the Mediterranean and Black Sea fleets decreased 0.4% while the Northeast Atlantic fleet increased its GVA by 2% (Tab. 3).

In general, the SSCF was found to be more vulnerable or negatively impacted than the LSF during 2020 and 2021, partly because fuel prices decreased less for the SSCF than for the LSF (see Tab. 2). Recent studies show that COVID-19 pandemic has affected the EU SSCF in different ways. Coll et al. (2021) found that the Catalan SSCF was more resilient than the LSF to the COVID-19 disruptions, maintaining higher landings during the COVID-19 lockdown in comparison to the period 2017-19. Sabatella et al. (2020) estimated an average 11% reduction of the Italian SSCF's annual revenues in 2020, with significant differences across geographical areas (e.g. ranging from a 21% decrease in Southern Sicily to a 6% decrease in Adriatic Apulia). This wide range is related to the fishing effort; indeed, with the exception of the first two lockdown weeks, fishing activities in some areas reverted to the average level of the period before COVID-19, whereas in other areas the stop lasted longer. The different behaviours were largely determined by the existing diverse commercial structures and sales systems; the fishing ports that rely on tourism being the ones most affected. Russo et al. (2021) found that the SSCF was the least impacted fleet in the Adriatic Sea, suffering a 30% reduction in both landings and profits; while the small bottom otter trawling was the most impacted fishery with an 85% decrease in landings and profits. In the EU context, the SSCF is more likely to supply fresh products of higher value, with shorter value chains that often include the direct sale of fresh seafood to restaurants. As such, the reduction in tourism due to travel restrictions (Bakar and Rosbi 2020) and restaurant visits during national lockdowns were more impactful for some parts of the SSCF.

These diverse commercial structures, sales systems and species caught, including the presence of tourism and the importance of the SSCF in relation to the LSF, can be some of the main reasons for differences in the COVID-19 impact between regions and fleets. In France, the Mediterranean fleet

[8] This €188 million decrease in fuel costs from 2019 to 2020 can be explained by a decrease in the fuel price (about €161 million) and decrease in activity reflected in a decrease in the fuel consumption (about €26 million), according to Table 2.

Table 3. Landings in weight (thousand tonnes) and value, GVA and gross profit (million EUR) of the EU-27 fleet 2018–21 (2020 and 2021 are nowcast estimates).

		Live weight of landings				Value of landing				Gross value added				Gross profit			
Supra_reg	Country	2018	2019	2020	2021	2018	2019	2020	2021	2018	2019	2020	2021	2018	2019	2020	2021
NAO	BEL	22.3	21.2	20.0	19.7	79.2	75.2	68.6	59.8	39.8	36.7	36.8	28.4	11.8	9.8	12.3	7.0
	DEU	258.4	204.9	193.7	181.2	162.5	121.7	109.5	108.8	98.8	61.5	59.9	56.6	46.7	17.9	18.8	15.5
	DNK	787.8	633.5	700.5	660.2	448.2	408.4	396.6	354.8	304.9	275.2	283.6	239.9	180.3	161.2	179.2	144.8
	ESP	340.7	311.3	298.2	288.0	743.8	732.7	704.8	684.6	461.7	451.8	460.1	434.9	105.0	94.6	116.1	100.1
	EST	66.9	66.2	55.8	57.6	14.4	13.8	12.0	11.5	9.5	8.1	7.1	6.6	4.7	2.9	2.4	2.1
	FIN	147.6	135.1	112.2	96.4	33.2	33.5	28.1	25.1	22.0	17.4	15.6	13.1	14.0	8.5	8.3	6.6
	FRA	403.2	373.7	362.0	348.9	908.9	882.1	835.2	797.5	485.4	435.1	447.2	400.4	139.6	110.4	138.2	104.9
	IRL	220.3	207.7	217.2	196.7	316.5	299.3	271.1	262.2	170.3	145.9	143.4	123.1	72.3	49.8	51.5	36.7
	LTU	24.7	22.9	17.1	17.1	6.2	5.1	4.3	4.0	2.5	1.9	1.9	1.4	0.5	0.5	0.7	0.4
	LVA	70.4	69.6	61.3	64.2	20.2	16.1	14.1	14.8	11.0	7.6	6.9	7.0	5.7	3.2	2.8	2.7
	NLD	403.3	316.3	304.4	333.4	423.9	336.9	313.9	292.8	210.2	146.9	149.9	122.5	82.8	43.9	52.6	31.1
	POL	178.7	203.1	184.3	150.3	47.3	41.9	29.8	26.7	25.7	23.2	17.3	14.1	6.0	6.4	6.4	4.1
	PRT	153.4	165.4	166.0	160.1	357.2	355.1	356.5	349.9	237.3	228.5	245.8	228.7	101.6	87.9	105.8	92.2
	SWE	198.6	164.0	157.8	121.6	112.8	110.3	106.8	105.9	59.5	58.7	70.2	65.0	34.0	34.3	46.9	41.4
NAO Total		3,276.6	2,894.9	2,850.3	2,695.5	3,674.5	3,432.1	3,251.3	3,098.5	2,138.5	1,898.6	1,945.6	1,741.8	805.2	631.3	742.0	589.6
MBS	BGR	8.5	10.3	7.0	6.2	7.8	6.2	4.9	4.5	5.6	4.5	3.3	2.6	4.5	3.5	2.2	1.7
	CYP	1.5	1.5	1.5	1.5	6.6	6.9	6.9	6.9	2.7	2.9	2.9	2.8	1.5	1.6	1.6	1.6
	ESP	87.6	76.6	75.6	74.5	317.7	278.7	275.4	272.7	195.6	174.0	170.6	159.3	54.9	51.4	45.5	36.2
	FRA	20.3	20.6	19.9	19.9	149.6	122.1	116.4	114.5	114.4	82.2	77.6	71.7	41.5	23.8	20.4	14.4
	GRC	68.2	71.0	71.2	70.3	440.5	424.5	425.5	434.8	276.7	266.4	256.4	244.4	115.2	121.1	111.1	100.6
	HRV	69.4	63.3	70.3	68.3	60.3	57.5	59.3	56.4	52.2	50.5	49.8	44.3	25.0	23.8	21.8	17.0
	ITA	191.7	174.0	174.0	174.0	921.7	856.9	856.9	863.2	565.2	543.3	560.7	535.1	296.8	294.2	306.6	281.0
	MLT	2.7	2.4	2.5	1.7	13.5	12.2	10.8	8.4	8.4	7.6	6.4	3.7	2.6	3.5	2.6	-0.0
	PRT	0.1	0.0	0.0	0.0	0.6	0.4	0.4	0.4	0.4	0.2	0.2	0.1	0.2	-0.1	-0.1	-0.1
	ROU	7.7	7.1	4.5	4.3	4.0	4.0	2.5	2.5	2.7	2.9	1.6	1.4	1.8	2.1	1.0	0.9
	SVN	0.1	0.1	0.2	0.2	0.8	0.8	1.2	1.2	1.7	1.7	2.1	2.0	1.3	1.4	1.6	1.5
MBS Total		458.0	427.0	426.6	421.0	1,923.2	1,770.2	1,760.1	1,765.5	1,225.6	1,136.3	1,131.5	1,067.5	545.2	526.2	514.4	454.6
TOTAL		3,734.6	3,322.0	3,277.0	3,116.5	5,597.6	5,202.3	5,011.4	4,864.0	3,364.1	3,034.9	3,077.1	2,809.4	1,350.4	1,157.5	1,256.5	1,044.2

Source: own elaboration from STECF's 2021 AER.

was less impacted than the fleet in the Atlantic (–6% vs −14% in landings value) (Ifremer SIH, 2021a,b). In the Atlantic, the most impacted segment was composed of vessels targeting demersal species (monkfishes, hake, etc.) whose markets were disrupted by the closure of restaurants (Guyader et al., 2021). Similarly, in Sweden the prices of the Norway lobster and north Atlantic prawn initially dropped due to the decrease in demand from restaurants (STECF, 2021).

Some of the fishers who continued to work during the lockdown tried to overcome the demand disruption during the COVID-19 pandemic by making changes to their sales channels, strengthening their collaboration with first sale markets as well as local fishmongers (Sabatella et al., 2020). One market strategy pursued by parts of the SSCF was to distribute and sell their products directly to consumers (e.g. through web shops, direct sales and home delivery) with the help of digital technologies (e.g. social networks) and sometimes through Fisheries Local Action Groups (FLAGs) (see e.g. Sabatella et al., 2020; CBI, 2020). The Galician SSCF, for example, rapidly adapted to the abrupt shock by selling their products to other intermediaries and clients, namely the canning industry (Villasante et al., 2021). There is evidence that these alternative seafood markets and networks experienced a temporary boost under the pandemic due to proximity to local actors and markets (Stoll et al., 2020; The Guardian, 2021; Costa et al., 2022). Some of these changes may constitute a shift in the market demand (e.g. by attracting new customers who had never previously tried zero mile food and home delivery) that remains in place after the COVID-19 pandemic passes (FAO, 2020a; Ruiz-Salmón et al., 2021; Costa et al., 2022).

Conversely, studies have noted increased demand for canned and frozen seafood products during the COVID-19 pandemic, which primarily benefits some large-scale segments (OECD, 2020; European Commission et al., 2021). The characteristics of canned products in terms of durability, ease of storage and versatility for final consumers have favoured their immediate collection at households (e.g. Spain), which would probably imply a decrease in demand due to the accumulation of stocks in the next years. However, not all canning enterprises have positively adapted; some small and medium enterprises suffered most due to the abrupt decrease of revenues because of their high exposure to some HORECA channels (Villasante et al., 2021).

A disproportionate decline in economic performance also affected fisheries that used to export most of their production to other EU or foreign markets. Some major markets such as Spain, Italy, France or China had been largely closed, especially during the first wave of COVID-19 in Europe (March to June) (FAO, 2020a; STECF, 2020, 2021). Cold storage was commonly used to stabilize prices when importing markets were closed or demand was low, resulting in only modest decreases in first-sale prices compared to 2019 (STECF, 2020, 2021).

EU countries took numerous measures to mitigate the effects of the COVID-19 pandemic on the fisheries sector (e.g. ensuring the continuity of food supply, expanding home delivery and direct sales, and supporting national and local production through consumer awareness campaigns), and complemented them with enhanced financial support and investment to the fisheries sector. In March 2020, EU legislators approved a range of urgent relief measures under the Coronavirus Response Investment Initiative (CRII) through the EU Regulation 2020/560, further supplemented by the Coronavirus Response Investment Initiative (CRII+) in April, enabling the use of structural funds, including the European Maritime and Fisheries Fund (EMFF), to strengthen the healthcare system and support economic activities (EU, 2020; Pititto et al., 2021). It also included immediate specific EMFF measures that included enlarging the scope of the EMFF to allow compensation for economic losses caused by the pandemic, more flexibility in allocating financial resources within the operational programme of each EU country, and a simplified procedure for amending operational programmes to introduce the new measures quicker (EU, 2020). These new measures included compensation for the temporary cessation of fishing activities and aid for the storage of fishery products. In addition, the new State Aid Temporary Framework enabled EU countries to use full flexibility foreseen under EU State aid rules to provide relief to economic operators in the fisheries sector hit by the COVID-19 pandemic (STECF, 2020, 2021; Pititto et al., 2021). Nearly all EU member states reported the use of mitigation measures, while EMFF was used by at least 11 countries (European Commission et al., 2021). The largely positive economic performance in 2020 suggests that the intended outcomes of these support measures were mostly reached. This is a generalised finding, as for some fleet segments the support may not have been enough while for other fleet segments support may not have been necessary in 2020.

During the second wave of the COVID-19 pandemic, containment measures were in most cases less restrictive with more permitted economic activities. So far, during the successive waves, the containment measures affecting the EU fisheries sector and the whole EU economy in general continued to diminish.

The nowcasts results obtained in 2021 for 2020 are also more positive than those estimated in the 2020 AER (for t+2), which is mostly explained by features of the nowcasting procedure introduced for the 2020 AER. As COVID-19 was having a large impact on the fishing sector at the time of the 2020 AER nowcasting exercise (i.e., mid-2020), additional information on the general activity level of the fleet was used to obtain a 'COVID-19 adjustment' or correction factor. This departed from the general AER nowcasting methodology. The additional information incorporated to estimate the change in the fishing effort and landings was based on the average of four data sources: (1) aggregated catch reported data, (2) Automatic Identification System (AIS) data on vessel activity, (3) a survey sent to main producer organisations and stakeholders, and (4) countries' monthly landings, where available. The more negative results obtained in the 2020 AER (STECF, 2020) are partly due to the early stage at which the estimations were performed. During the first lockdown, most fishing fleets reduced their fishing effort and landings, but increased it after the first lockdown (i.e., second half of the year) (e.g. Coll et al., 2021; Russo et al., 2021; STECF, 2021). Hence, estimations during the first lockdown period or just after it would tend to be more negative than those that could fully incorporate the recovery during the months after the first lockdown.

Another general trend observed when comparing these different data sources for the adjustment factor used in the

AER 2020 was that the survey results tended to be lower (i.e., more pessimistic) than the preliminary landings or fishing effort data[9]. This trend is consistent with the possibility of a response bias based on low global economic expectations and uncertainty (see for e.g. Bartik et al., 2020). It could also be a result of self-interest or 'motivated reasoning' from the industry survey respondents aimed at producing a negative nowcast which would facilitate public financial support. This potential for self-interested responses should be explored further as industry-science collaboration continues to increase in fisheries science and management advice.

There may be more lasting environmental impacts in addition to these economic impacts for some fisheries. The reduction in fishing activity experienced in some fisheries during the pandemic may lead to increases in biomass of some of the fish stocks where fishing mortality has decreased significantly (Korten, 2020). Increases in the stock biomass of overfished stocks would positively contribute to the efforts to bring further EU commercial fish stocks to maximum sustainable levels as envisaged by the EU Common Fisheries Policy (European Commission, 2013).

6 Conclusions

The COVID-19 pandemic and the resulting economic and social crisis represent a global shock that has affected all sectors, including fisheries. In this paper, we analysed the immediate implications of the COVID-19 impact on the economic performance of the EU fishing fleet. Our study provides insights that may be useful for EU policy makers, the fishing industry and the scientific community in dealing with the economic impacts in the short term.

Results show that, on average, the profitability of the EU fishing fleet was overall not severely affected by the COVID-19 pandemic despite decreases in fishing activity, landings weight and value mainly during the first lockdown. This is mainly due to a corresponding reduction in fishing costs from a decreased fishing activity and low fuel prices. Economic performance also likely benefited from the early response of fisheries administrations to support the sector. However, COVID-19 impacts are not homogeneously distributed among fleets and regions. The small-scale coastal fleet and the Mediterranean and Black seas fleets experienced a decrease in their economic performance, likely due to COVID-19 disruptions in key markets. Data are available at fleet segment level, so more specific analyses could be performed for certain fleets. Some fishers even benefited from increases in the demand of certain species and by adapting their commercialisation strategies.

Estimates for 2021 show that the economic performance of the EU fishing fleet worsens compared to the last years and the financial viability of less resilient EU fleets remains vulnerable to potential new COVID-19 outbreaks and other disruptions such as fuel price increases and Brexit.

[9] See also Pita et al. (2020) for another example of a survey to investigate the impact of COVID-19 in the fisheries sector, with more qualitative results and recommendations.

Acknowledgements. The opinions expressed in this paper are those of the authors and do not necessarily reflect their institutions positions or policy.

The authors would like to acknowledge their participation in the STECF expert working groups 20-03, 20-06, 21-03, and 21-08 to prepare the 2020 and 2021 Annual Economic Reports on the European fishing fleet, which set the basis of this paper.

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Cite this article as: Carpenter G, Carvalho N, Guillen J, Prellezo R, Villasante S, Andersen JL, Mravlje EA, Berkenhagen J, Brigaudeau C, Burke B, Santos AC, Cano S, Contini F, Da-Rocha J-M, Davidjuka I, Martínez FMF, Fontaneda-López I, Gambino M, Caballero EG, Guyader O, Herring J, Hoekstra G, Ioannou M, Jackson E, Jung A, Kazlauskas E, Keatinge M, Kuzebski E, Leonardi S, Le Grand C, Lees J, Mancebo-Robledo CM, Minne M-D, Mol A, Quintana MM, Nicheva S, Pokki H, Do Ó JR, Rodríguez A, Sabatella RF, Sciberras A, Souffez A, Stroie C, Swahnberg H, Tzouramani I, Viana MV, Verlé K, Virtanen J, Vukov I, Zhelev K. 2023. The economic performance of the EU fishing fleet during the COVID-19 pandemic. *Aquat. Living Resour.* 36: 2

Appendix A: Methodology: forecasting relations

Landed weight (MBS and OFR fleet segments)

$$Landed\_weight_{t+1,f} = Landed\_weight_{t,f}\frac{Number\_vessels_{t+1,m,l}}{Number\_vessels_{t,m,l}} \tag{A.1a}$$

$$Landed\_weight_{t+2,f} = Landed\_weight_{t+1,f}(1 - Covid\_adj_f) \tag{A.1b}$$

where f represents a fleet segment; where m represents an EU country; where l represents a length class.
The number of vessels for $t+1$ is based on the change in the number of vessels from one year to the other, obtained from the evolution of active vessels in the EU Fleet Register.
Landed weight (NAO fleet segments)

$$TAC\_Landings_{t+1,f} = TAC_{t+1}Relative\_stability_m Swaps_{t,m} Uptake_{t+1,m} Segment\_Share_{t,f} \tag{A1.c}$$

$$Non\_TAC\_Landings_{t+1,f} = Non\_TAC\_Landings_{t,f}\frac{Sea\_days_{t+2,f}}{Sea\_days_{t+1,f}} \tag{A1.d}$$

$$Landed\_weight_{t+1,f} = TAC\_Landings_{t+1,f} + Non\_TAC\_Landings_{t+1,f} \tag{A1.e}$$

$$Landed\_weight_{t+2,f} = Landed\_weight_{t+1,f}(1 - Covid\_adj_f) \tag{A1.f}$$

The TACs are reported in Council regulations and relative stability is calculated as the relative shares in year t. Quota swaps are calculated using the difference with adapted quota in the FIDES dataset, which also indicates quota uptake. Fleet segment share is calculated based on the DCF landings.
Sea days (NAO fleet segments)

$$Sea\_days_{t+1,f} = Sea\_days_{t,f}\left(\left(\Sigma\left(\frac{TAC\_Landings_{t,f,a}Price_{t+1,f,s}\theta_{f,a}}{\Sigma\, TAC\_Landings_{t,f,a}Price_{t,f,s}\theta_{f,a}}\left(\frac{TAC_{t+1,f,a}}{TAC_{t,f,a}}\right)^{\chi_a}\left(\frac{SSB_{t+1,f,a}}{SSB_{t,f,a}}\right)^{-\gamma_a}\right) - 1\right)\frac{TAC\_Landings_{t,f}}{Landings\_weight_{t,f}} + 1\right) \tag{A.2a}$$

$$Sea\_days_{t+2,f} = Sea\_days_{t+1,f}(1 - Covid\_adj_f) \tag{A.2b}$$

where a represents a total allowable catch (TAC); where s represents a TAC species; where θ represents a fleet segment effort driver for the TACs that influence fishing activity; where χ represents an activity-landing flexibility rate (1/catch-effort coefficient); where γ represents an activity-stock flexibility rate (stock-catch coefficient/catch-effort coefficient).
Effort drivers were defined as a function of percentage catch composition and quota uptake and confirmed or adjusted by member state experts. Stock-catch coefficients are set at 0.8 for demersal species and 0.1 for pelagic species. Catch-effort coefficients are set at 1 as a default parameter (constant catch per unit effort). Spawning stock biomass (SSB) data comes from ICES stock assessments. For the Baltic Sea stocks, SSB is available to year $t+1$, whereas the North Sea and North Atlantic stocks are only available to year t.
Landed value (MBS and OFR fleet segments)

$$Landed\_value_{t+1,f} = Landed\_value_{t,f}\frac{Landed\_weight_{t+1,f}}{Landed\_weight_{t,f}}\frac{Fish\_price_{t+1,m}}{Fish\_price_{t,m}} \tag{A.3a}$$

$$Landed\_value_{t+2,f} = Landed\_value_{t+1,f}\frac{Landed\_weight_{t+2,f}}{Landed\_weight_{t+1,f}}\frac{Fish\_price_{t+2,m}}{Fish\_price_{t+1,m}} \tag{A.3b}$$

Landed value (NAO fleet segments)

$$Landed\_value_{t+1,f} = Landed\_value_{t,f}\frac{Landed\_weight_{t+1,f}}{Landed\_weight_{t,f}}\frac{Fish\_price_{t+1,m,s}}{Fish\_price_{t,m,s}} \tag{A.3c}$$

$$Landed\_value_{t+2,f} = Landed\_value_{t+1,f}\frac{Landed\_weight_{t+2,f}}{Landed\_weight_{t+1,f}}\frac{Fish\_price_{t+2,m,s}}{Fish\_price_{t+1,m,s}} \tag{A.3d}$$

Fishing income (All fleet segments)

$$Landed\_income_{t+1,f} = Landed\_income_{t,f}\frac{Landed\_value_{t+1,f}}{Landed\_value_{t,f}} \tag{A.4a}$$

$$Landed\_income_{t+2,f} = Landed\_income_{t+1,f}\frac{Landed\_value_{t+2,f}}{Landed\_value_{t+1,f}} \tag{A.4b}$$

Other income (All fleet segments)

$$Other\_income_{t+1,f} = Other\_income_{t,f}\frac{Number\_vessels_{t+1,m,l}}{Number\_vessels_{t,m,l}} \tag{A.5a}$$

$$Other\_income_{t+2,f} = Other\_income_{t+1,f}\frac{Number\_vessels_{t+2,m,l}}{Number\_vessels_{t+1,m,l}} \tag{A.5b}$$

For the few fleet segments that do not report costs (most notably DEU TM40XX), landings income is not reported based on landings value as it would skew the economic indicators (e.g. gross profits).
FTE (MBS and OFR fleet segments)

$$FTE_{t+1,f} = FTE_{t,f}\frac{Number\_vessels_{t+1,m,l}}{Number\_vessels_{t,m,l}} \tag{A.6a}$$

$$FTE_{t+2,f} = FTE_{t+1,f}(1 - Covid\_adj_f) \tag{A.6b}$$

FTE (NAO fleet segments)

$$FTE_{t+1,f} = FTE_{t,f}\frac{Sea\_days_{t+1,f}}{Sea\_days_{t},f} \tag{A.6c}$$

$$FTE_{t+2,f} = FTE_{t+1,f}\frac{Sea\_days_{t+2,f}}{Sea\_days_{t+1,f}} \tag{A.6d}$$

Crew costs (all fleet segments)

$$\left(Crew\_wages_{t+1,f} + Unpaid\_labour_{t+1,f}\right) = \left(Crew\_wages_{t,f} + Unpaid\_labour_{t,f}\right)\frac{Landed\_value_{t+1,f}}{Landed\_value_{t,f}} \tag{A.7a}$$

$$\left(Crew\_wages_{t+2,f} + Unpaid\_labour_{t+2,f}\right) = \left(Crew\_wages_{t+1,f} + Unpaid\_labour_{t+1,f}\right)\frac{Landed\_value_{t+2,f}}{Landed\_value_{t+1,f}} \tag{A.7b}$$

Energy consumption (MBS and OFR fleet segments)

$$Energy\_consumption_{t+1,f} = Energy\_consumption_{t,f}\frac{Number\_vessels_{t+1,m,l}}{Number\_vessels_{t,m,l}} \tag{A.8a}$$

$$Energy\_consumption_{t+2,f} = Energy\_consumption_{t+1,f}(1 - Covid\_adj_f) \tag{A.8b}$$

Energy consumption (NAO fleet segments)

$$Energy\_consumption_{t+1,f} = Energy\_consumption_{t,f}\frac{Sea\_days_{t+1,f}}{Sea\_days_{t,f}} \tag{A.8c}$$

$$Energy\_consumption_{t+2,f} = Energy\_consumption_{t+1,f} \frac{Sea\_days_{t+2,f}}{Sea\_days_{t+1,f}} \tag{A.8d}$$

Energy costs (All fleet segments)

$$Energy\_costs_{t+1,f} = Energy\_costs_{t,f} \frac{Energy\_consumption_{t+1,f}}{Energy\_consumption_{t,f}} \times \frac{Fuel\_price_{t+1,m}}{Fuel\_price_{t,m}} \tag{A.9a}$$

$$Energy\_costs_{t+2,f} = Energy\_costs_{t+1,f} \frac{Energy\_consumption_{t+2,f}}{Energy\_consumption_{t+1,f}} \times \frac{Fuel\_price_{t+2,m}}{Fuel\_price_{t+1,m}} \tag{A.9b}$$

Fuel prices are obtained from the Eumofa website for each country.
Other variable costs (MBS and OFR fleet segments)

$$Other\_variable\_costs_{t+1,f} = Other\_variable\_costs_{t,f} \frac{Number\_vessels_{t+1,m,l}}{Number\_vessels_{t,m,l}} \tag{A.10a}$$

$$Other\_variable\_costs_{t+2,f} = Other\_variable\_costs_{t+1,f}(1 - Covid\_adj_{f}) \tag{A.10b}$$

Other variable costs (NAO fleet segments)

$$Other\_variables\_costs_{t+1,f} = Other\_variable\_costs_{t,f} \frac{Sea\_days_{t+1,f}}{Sea\_days_{t,f}} \tag{A.10c}$$

$$Other\_variables\_costs_{t+2,f} = Other\_variable\_costs_{t+1,f} \frac{Sea\_days_{t+2,f}}{Sea\_days_{t+1,f}} \tag{A.10d}$$

For following fixed cost relations, the same approach is taken for NAO and MBS/OFR fleet segments.
Repair and maintenance costs (All fleet segments)

$$Repair\_costs_{t+1,f} = Repair\_costs_{t,f} \frac{Number\_vessels_{t+1,m,l}}{Number\_vessels_{t,m,l}} \tag{A.11a}$$

$$Repair\_costs_{t+2,f} = Repair\_costs_{t+1,f} \frac{Number\_vessels_{t+2,m,l}}{Number\_vessels_{t+1,m,l}} \tag{A.11b}$$

Non-variable costs (All fleet segments)

$$Non\_variable\_costs_{t+1,f} = Non\_variable\_costs_{t,f} \frac{Number\_vessels_{t+1,m,l}}{Number\_vessels_{t,m,l}} \tag{A.12a}$$

$$Non\_variable\_costs_{t+2,f} = Non\_variable\_costs_{t+1,f} \frac{Number\_vessels_{t+2,m,l}}{Number\_vessels_{t+1,m,l}} \tag{A.12b}$$

Investment (All fleet segments)

$$Investment_{t+1,f} = Investment_{t,f} \frac{Number\_vessels_{t+1,m,l}}{Number\_vessels_{t,m,l}} \tag{A.13a}$$

$$Investment_{t+2,f} = Investment_{t+1,f} \frac{Number\_vessels_{t+2,m,l}}{Number\_vessels_{t+1,m,l}} \tag{A.13b}$$

Depreciation (All fleet segments)

$$Depreciation_{t+1,f} = Depreciation_{t,f} \frac{Number\_vessels_{t+1,m,l}}{Number\_vessels_{t,m,l}} \tag{A.14a}$$

$$Depreciation_{t+2,f} = Depreciation_{t+1,f} \frac{Number\_vessels_{t+2,m,l}}{Number\_vessels_{t+1,m,l}} \tag{A.14b}$$

Assets value (All fleet segments)

$$Asset\_value_{t+1,f} = Asset\_value_{t,f} \frac{Number\_vessels_{t+1,m,l}}{Number\_vessels_{t,m,l}} \tag{A.15a}$$

$$Asset\_value_{t+2,f} = Asset\_value_{t+1,f} \frac{Number\_vessels_{t+2,m,l}}{Number\_vessels_{t+1,m,l}} \tag{A.15b}$$

Opportunity cost of capital (All fleet segments)

$$Opportunity\_cost_{t+1,f} = Asset\_value_{t+1,f} Real\_interest_{t+1,m} \tag{A.16a}$$

$$Opportunity\_cost_{t+2,f} = Asset\_value_{t+2,f} Real\_interest_{t+2,m} \tag{A.16b}$$

where

$$Real\_interest = \frac{(1+i)}{(1+\pi)} - 1 \tag{A.17}$$

where i represents the (nominal) interest rate and π for the inflation.

The inflation by country was obtained from the general Consumer Price Index reported by EUROSTAT. The nominal interest rate by country was obtained from the European Central Bank.

Total employed (MBS and OFR fleet segments)

$$Employment_{t+1,f} = Employment_{t,f} \frac{Number\_vessels_{t+1,m,l}}{Number\_vessels_{t,m,l}} \tag{A.18a}$$

$$Employment_{t+2f} = Employment_{t+1,f} \frac{Number\_vessels_{t+2,m,l}}{Number\_vessels_{t+1,m,l}}. \tag{A.18b}$$