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Managing EU fisheries in the public interest

Results from the Bio-Economic Model of European Fleets

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New Economics Foundation (NEF)
is an independent think-and-do tank that inspires and demonstrates real economic wellbeing.

We aim to improve quality of life by promoting innovative solutions that challenge mainstream thinking on economic, environmental and social issues. We work in partnership and put people and the planet first.

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Summary

For too long, overfishing has cost Europe millions in lost landings, profits and jobs. Quotas and subsidies have been allocated to fleets regardless of their economic, social or environmental performance. The reformed Common Fisheries Policy, in force since 2014, is an opportunity for change. But change will not happen without action from member states.

Letting fish stocks grow to the point where they are most productive in perpetuity – their 'maximum sustainable yield' (MSY) – demands a reduction of fishing pressure for a set period of time. Reallocating quotas mean less fish for fleets that have traditionally received more access to the resource. While society would largely benefit, trade-offs must be made. European ministers must not shy away from making tough decisions that safeguard our fish stocks.

To date, attention has mostly focused on the short-term costs of transitioning to MSY. The long-term benefits of reaching MSY and the potential economic impacts of reallocating quotas have largely been ignored.

To understand the possible benefits and trade-offs involved in reallocating quotas and rebuilding fish stocks, the New Economics Foundation (NEF) analysed more than 221 EU fleets covering 73% of EU landings. We used the largest official dataset for the EU fleet, the Annual Economic Report (AER).

Our research shows that sustainable fisheries management and the reallocation of quotas – according to four alternative criteria 'job creation', 'fuel use', 'profit' and 'effort' – would increase revenues and create jobs more effectively than the current allocation based on historic share.

Reallocating fishing quotas to lower-carbon fleets would deliver an additional 14,584 jobs and save 624,000 tonnes of carbon per year, but profitability and wages would fall. Increasing quota to fleets that support more jobs per tonne of fish landed would create 102,000 jobs, but increase carbon emissions.

It is not realistic to fully allocate quotas according to a single criterion, but it is possible allocate shares of the quota. The current quota system is highly concentrated, so small allocations of 5% to 10% could bring huge economic benefits.

This new data was produced using the Bio-Economic Model of European fleets (BEMEF), which NEF has developed over the past two years with help from academics and institutions across the EU. BEMEF is the first model to estimate the economic impacts of reallocating fish quotas across fleets under alternative allocation criteria.

BEMEF also looks at how rebuilding fish stocks beyond MSY would affect landings, revenues, employment, profitability, wages and carbon emissions. We found that keeping our fish stocks below MSY in the last five years caused a total loss of 8.6 million tonnes of catch and €7.1 billion in revenues. Rebuilding most commercial EU fish stocks in North Atlantic waters to their MSY would deliver:

- 2,052,639 tonnes of additional fish per year, enough to meet the annual demand of 89.2 million EU citizens
- €1,565 million additional gross revenues per year
- €824 million additional net profits per year
- between 20,362 and 64,092 new jobs
- €8,273 in additional fishing wages each year.

All these benefits would accrue directly to the EU. The results are conservative because our analysis does not incorporate other fishing areas (i.e. Mediterranean) or non-commercial species.

As in all economic impact studies, these results depend on the assumptions underlying the model and the outcomes that we want to prioritise. For example, while it is possible to simultaneously deliver more profits, more jobs and higher wages at MSY, further jobs could come at the expense of wages and profits and vice-versa.

By making the data, results and assumptions accessible, we hope those involved in EU fisheries management – from fishers to ministers – can have a more honest conversation about the impacts and trade-offs involved in rebuilding fish stocks beyond MSY and reallocating quota.

EU member states can secure these benefits simply by implementing the reformed Common Fisheries Policy (CFP)[1] which came into force in January 2014. The CFP requires fishing limits for all stocks to be sustainable by 2015 where possible, and by 2020 at the latest (Art 2.2). It also requires member states to take social and environmental criteria into account when allocating fishing opportunities such as quota (Art 17).

Member states must do more to translate this potential into reality. The state of some fish stocks has improved. However, in December 2014 EU fisheries ministers set limits for 2015 above scientific recommendations for 63% of stocks. Few member states, if any, are looking seriously at alternative quota allocation.

To secure the best economic, social and environmental outcomes for their citizens, member states must focus their attention on:

- ensuring fishing opportunities and 'total allowable catches' do not exceed scientific advice
- reviewing how they allocate quotas across the fleet, and implementing pilot schemes to test new allocation criteria

Even though it is still at an early stage, BEMEF can help our policymakers do this.

1. Managing fisheries in the public interest

Fisheries management is a complex framework with many potential actors and outcomes. But the final decision on how much fish should be caught, by which method and by who, must be made in the public interest.

Fish stocks belong to all of us so they need be managed in the public interest. This means providing affordable, good fish products for citizens and stable, rewarding jobs for fishers and those in related industries.

To achieve this, two conditions must be met:

1 fish stocks need to be managed sustainably

2 fleets that perform better – that is, by delivering higher social, economic and environmental benefits – should be prioritised in the allocation of quotas (access to fish) and fisheries subsidies.

At the moment we are failing on both fronts. Most EU fish stocks are far from being managed sustainably; and quotas and most funding are allocated based on historic share of the catch, disregarding environmental and social impacts. But the reformed Common Fisheries Policy provides an opportunity to address both these issues.

Condition 1: Sustainable management of fish stocks

Fish are a renewable resource: if well managed they can provide endless benefits to society in terms of food, revenue and jobs. Over-exploiting fish populations means smaller catches, lower revenues and fewer jobs. Letting fish stocks grow is a precondition to being able to land more fish and consequently to creating more economic benefits for fishers and citizens. The highest yield that can be continuously taken from a stock is known as the 'maximum sustainable yield' (MSY).

> *"Maximum sustainable yield' means the highest theoretical equilibrium yield that can be continuously taken on average from a stock under existing average environmental conditions without significantly affecting the reproduction process."*
>
> **EC Common Fisheries Policy**

The benefits of reaching MSY can only be realised by ensuring fish populations stay above this level. As a yield, MSY can only be achieved through reaching a level of biomass (BMSY) that can support this level of fish mortality (FMSY). In reality the biomass must be larger than BMSY and the yield slightly less than MSY to ensure system stability.[2] These MSY levels are necessary conditions to increase the supply of fish, profits and jobs into the future.

Condition 2: Performance-based allocation of funds and quotas

Fish stocks are exploited by various types of fishing, each with different impacts. These range from providing jobs and making an economic profit, to causing severe environmental damage. Each type of fishing has different rates of unwanted catches and by-catch, while effects on marine habitats and levels of greenhouse gas emissions vary. People place different emphasis on each of these impacts, but what is clear is that some fleets offer better value to society than others.

'Best value to society' means different things to different people. We define 'best value to society' as delivering more of the things we want (e.g. good jobs, quality fish, healthy marine ecosystems, stable fishing industry) and less of the things we don't want (e.g. carbon emissions, damage to marine ecosystems, unstable employment, reliance on subsidies).

Gaining an understanding of how EU fleets perform in economic, social and environmental terms is essential to ensure that our public resources – access to fish through quotas and access to EU public funds – are allocated to those that create most value to society.

The Common Fisheries Policy

The EU's reformed Common Fisheries Policy (CFP)[3] entered into force in January 2014 and lays the foundations to meet both of the conditions described above.

The policy aims to restore and maintain fish stocks at levels capable of delivering MSY. It requires fishing limits for all stocks to be sustainable by 2015 where possible, and by 2020 at the latest (Art 2.2.). It also requires member states to take social and environmental criteria into account when allocating quotas across fleets (Art 17).

Article 2.2

"The CFP shall apply the precautionary approach to fisheries management, and shall aim to ensure that exploitation of living marine biological resources restorves and maintains populations of harvested species above levels which can produce the maximum sustainable yield.

"In order to reach the objective of progressively restoring and maintaining populations of fish stocks above biomass levels capable of producing maximum sustainable yield, the maximum sustainable yield exploitation rate shall be achieved by 2015 where possible and, on a progressive, incremental basis at the latest by 2020 for all stocks."

Article 17

"When allocating the fishing opportunities available to them, as referred to in Article 16, member states shall use transparent and objective criteria including those of an environmental, social and economic nature. The criteria to be used may include, inter alia, the impact of fishing on the environment, the history of compliance, the contribution to the local economy and historic catch levels. Within the fishing opportunities allocated to them, member states shall endeavour to provide incentives to fishing vessels deploying selective fishing gear or using fishing techniques with reduced environmental impact, such as reduced energy consumption or habitat damage."

2. Fisheries management in the EU

There are many fisheries management approaches underway in the EU. An understanding of the trends, practices and potential is essential to improve the health of fish stocks and the fishing industry.

The state of EU fish stocks: Half full? Or half empty?

EU fish stocks have been overfished for many decades. This means the current fish population is supplying fewer fish and less profit than if they had been managed above MSY levels. The state of some stocks is improving, but progress is slow and uneven.

The most recent communication by the European Commission (EC) on the state of EU fish stocks[4] shows that the number of stocks outside safe biological limits (where the biomass is below a biomass precautionary approach reference point) in the North-East Atlantic and adjacent waters fell significantly from 32 stocks in 2005 to 17 in 2014[5]. The communication also shows that as a percentage the number of fish stocks that are overfished has also fallen and now stands at 45%, or roughly half of the stocks for which enough information was available. One troubling sign is that 2014 saw increase in this figure despite the longer downward trend.[6]

It is important to note that keeping fish stocks within safe biological limits is different to keeping stocks above biomass levels that are capable of producing MSY. There is a difference between avoiding collapse and maximising returns for society.

There are two large barriers to moving fish populations beyond MSY. The first one is lack of information about the stocks. Accurate information on the available fish stock biomass in EU waters enables appropriate catch quotas to be set. Unfortunately, the health of many EU fish stocks is unknown.

In the Northeast Atlantic, half of the fish stocks by gross tonnage have been assessed. In the Mediterranean and Black Sea this number falls to less than a quarter.[7] Current funding for data collection, control and enforcement is just 1.5% of the value of landings and less than other subsidy schemes such as engine replacement. There is a strong case to increase this. For every euro invested in data collection, control and enforcement, there is a potential return of €10 if these mechanisms aid in the transition to MSY fisheries.

The second barrier to fish populations reaching MSY is that scientific advice is not always taken into account when deciding how much fish to catch – an issue with the quota setting process.

The issue of discards (fish thrown overboard as unwanted by-catch or because it is in excess of quota) is directly related to both of these barriers. In its current design the quota system is landings-based rather than catch-based, leaving room for discards to raise fishing mortality above sustainable level. In addition, much of this discarding has not been recorded and thus impacts data collection and stock assessment.

How much fish should we catch? Setting annual fishing limits

Every year fisheries ministers agree how much fish should be caught in EU waters by setting the 'total allowable catch' (TAC) for 36 commercially fished species in different fishing areas around EU waters. In total there are 220 TACs to be set.[8] TACs are set on an annual basis for most stocks and every two years for deep-sea species. The gradual introduction of multi-annual plans from 2015 onwards will see some of these TACs fixed for more than one year, rather than set on an annual basis.

The agreement on how much fish to catch for the year starts with a proposal from the European Commission. The proposal includes recommendations on the TACs depending on the state of the stocks in question. The Council of Ministers in charge of fisheries then meets to agree the final TACs.[9]

The EC relies on two bodies for scientific advice: the Scientific, Technical and Economic Committee for Fisheries (STECF) and the International Council for the Exploration of the Sea (ICES). The EC abides by scientific advice for most of the TACs it proposes. But in its latest proposal[10] it was clear advice had not been followed for a significant number.

Not exceeding scientific advice is clearly a precondition if we are to restore and maintain fish stocks above biomass levels able to deliver maximum sustainable yield.

For many years scientific advice has not been given the attention it deserves. Between 1987 and 2011 TACs were set higher than scientific recommendations (made by ICES – the International Council for the Exploration of the Sea) in 68% of decisions; and in excess of 33% over recommended levels. In 2014, 31 out of 69 stocks were fished above scientific advice.[11,12]

The most recent agreements by fisheries ministers on TACs for 2015 also failed to follow scientific advice.

In the October 2014 Council, ministers agreed fishing limits for ten Baltic Sea stocks including herring, cod, salmon, plaice, sprat. For five stocks these were set at above scientific recommendations.[13]

In the November 2014 Council, ministers agreed fishing limits for 2015-16 for 20 Total Allowable Catches (TACs) related to six deep sea species. Of the 16 TACs that can be compared to scientific advice, 11 were set above scientific recommendations.[14]

In the December 2014 Council, ministers agreed 2015 fishing limits for 101 TACs in North Western Waters. Of the 97 TACs for which scientific advice was available, 61 were set above recommendations and only 36 set according to or below.[15]

> *"Sometimes scientific advice on how much of a certain species should be caught is followed to the letter, but it is not unusual for ministers to agree on levels which are very different from the European Commission's initial proposals."*[16]

Who gets to fish? Allocating quota across the EU fleet

The share of the total allowable catch per species is divided between EU member states under a system known as relative stability.[17] This keeps the national share of quotas stable in relation to each other, even when the total quantity of fish that can be caught varies according to the productivity of the fish stocks.[18]

It is then up to each national government to decide how to allocate their national share of TACs across their fleets. At the moment most EU countries do this on the basis of historic catch share.

The new CFP requires criteria for the allocation of quotas to be transparent and countries to take social and environmental standards into account. However, an informal review of current action by member states in relation to implementation of Article 17, shows that little of this is happening despite the claims of some countries, such as Denmark, Spain and the UK.

The process of reallocating quotas from some segments of the fleet to others is not a simple one. Those who have always had access to quotas, claim the right to them because they have invested and shaped their business under the assumption that they will have access to fish quotas. Those who have no or limited access to quotas claim their right to a fair share, on the basis that their fleet delivers more benefits to society by supporting more jobs in coastal communities and fishing in a more environmentally friendly way.

This imbalance seems to be the case in the UK, where the small-scale fishing sector employs 79% of the fishers[19] but currently have access to only 2% of the quota.[20] Similar cases can be found in other EU countries such as Portugal, Spain, France and Denmark.

It would not make sense to allocate quota to the inshore fleet from vessels which target fish stocks far from the coast. But there is clearly a case to review quota allocation in areas where there is an overlap between different types of fleets and fishing gears.

The economic impacts of getting fish stocks to beyond MSY and reallocating quota

Letting fish stocks grow to biomass levels able to deliver MSY requires reducing the fishing pressure for a few years. Reallocation means a departure from the current practice of distributing quota among fleets based on historic share. With careful management there could be wide societal benefits to these actions, but there are trade-offs between the short-term and the medium-long term as well as winners and losers among the fleets.

Over the past decades, most of the political debate has focused on the short-term costs of making a transition to MSY – a natural consequence of the annual quota setting procedure – with less attention being paid to the long-term benefits of reaching MSY. On quota allocation only a few studies have attempted to define and analyse potential criteria[21,22,23] and no analysis has been done on the economic impacts of reallocating quota across the fleet.

Among studies of reaching MSY or MEY (maximum economic yield) fisheries there is widespread agreement that there are significant economic benefits. Each of these previous reports comes with its own unique focus in terms of geography, species, and economic modelling technique, detailed in Table 1.

Our report, *No catch investment,*[24] estimated the time that it would take to restore fish stocks to MSY if we stopped fishing completely and the cost of the transition in terms of forgone revenues for fishers. The report found that if we completely stopped fishing over-exploited stocks today, most could be fully restored within five years, with the total EU fish supply surpassing current levels within four years. It would cost €10.5 billion over 9.4 years to compensate fishers during the transition period, but the investment would generate €15.6 billion revenue by 2023. This is 50% return on investment, or €1.5 for every €1, originally invested after 10 years. All investment costs would be recovered within 4.6 years, with each year thereafter seeing a net benefit on the investment.

Like all economic impact studies these results depend on the assumptions underlying the model and the outcomes that we want to prioritise. For example, one could assume that the additional wealth created from rebuilding fish stocks will translate into more jobs, or into more profits, or into higher wages. There are trade-offs between what increased earnings go towards.

Far too often these assumptions escape public scrutiny and this creates situations by which two economic studies might come up with contradictory results.

This was the case in 2012 when consultants for the European Commission estimated that getting fish stocks to MSY would lead to a loss of 14,000

Table 1. Summary of reports estimating the economic impacts of reaching MSY in Europe

Study	Report	Coverage	Biological basis	Results
Arnason *et al.* (2009)	Sunken Billions	Global	Calculated MEY from reported catch, estimated discards and sample MSY/ biomass ratios	$37–67 billion annually or $2 trillion over the past three decades (€40 billion and €1.6 trillion in 2014 euros)
Crilly and Esteban (2012)	Jobs Lost at Sea	North Atlantic	Single stock MSY estimates for 43 stocks	3.53 million tonnes of landings worth €3.2 billion annually (€3.3 billion in 2014 euros) and 100,000 jobs (32,000 fishing and 69,000 processing)
Sumaila *et al.* (2012)	Benefits of Rebuilding Global Marine Fisheries Outweigh Costs	Global	MSY estimates for 1066 taxa	8.5 billion tonnes and $12.8 billion in catch value (€10.2 billion in 2014 euros)
Salz (2012)	Socio-Economic Benefits of a Bold EU Fisheries Reform	EU landings	A 1.8-3.7% annual decline in landings to 2022 compared to a recovery of landings to 20-40% above 2009	The EU could produce 1.4–2.8 million tonnes of fish boosting income up to €2.1 billion (€2.1 billion in 2014 euros) and save 35,000 jobs
Merino *et al.* (2014)	Estimating the Economic Loss of Recent North Atlantic Fisheries Management	North Atlantic	Single stock MSY estimates with a MEY and multispecies adjustment	Benefits in the range of €2.5–32 billion
Natural Capital Committee (2014)	The State of Natural Capital	UK landings	1940–1970 catch levels	Estimates benefits to high yield fisheries of £1.4 billion (€1.6 billion)

fishing jobs,[25] whereas NEF estimated that we could create up to 100,000 jobs in fishing and processing.[26] Both studies took a similar approach, but the analysis for the Commission extrapolated continued reductions in capacity to 2022 and estimated a loss of 14,000 jobs and the doubling of fishing wages to attract new fishers, whereas NEF assumed that additional fish would lead to job creation due to the economic climate of low wages and high unemployment in Europe and the necessary employment required to land increased quantities of fish.

Some of the key factors that play a key role when estimating the potential impacts of fish stock restoration and the performance of the EU fleet include:

- **Fish prices:** Will these decrease because there is more fish available? What will be the balance between trends in aquaculture, trade and consumption?
- **Fuel prices:** Will these increase, decrease or remain stable? And how will this modify fleet behaviour?
- **MSY estimates:** As there are no official MSY estimates, which ones should be used? How can estimates be adjusted for multispecies considerations?
- **Catchability and fleet structure:** Will it become easier to catch fish as stocks rebuild and biomass increase? Will fleets save in fuel use and employ less people to do so?
- **Technological change:** What improvements in catch efficiency should be expected?
- **Policy change:** What new or existing policies should be included in economic modelling of fisheries?

These factors play a critical role in the final results of any economic impact analysis. There is a need to make the data and these assumptions more visible and accessible so that the community of stakeholders involved in EU fisheries management can have an informed conversation about the impacts and trade-offs involved in rebuilding fish stocks to MSY and reallocating quota.

3. The Bio-Economic Model of European Fleets

A bio-economic model is required to both progress our understanding of existing estimates and address some of the key issues they reveal. Current literature does not cover the impacts of maximum sustainable yield and quota allocations on specific EU fleets.

NEF's Bio-Economic Model of European Fleets (BEMEF) was developed to advance the modelling of EU fisheries using the most recent data and techniques; to open up the 'black box' of modelling; to illustrate the potential of MSY at a more disaggregated level; and to start new conversations around how to manage quota with a broader sense of public purpose.

In its structure, BEMEF can be described as a multi-period static equilibrium model. This approach follows closely from the 'Economic Interpretation of ACFM[27] Advice' (EIAA) model[28] developed at the University of Copenhagen.

The EIAA has been used by the European Commission in several annual assessments of the EU fishing fleet and the economic implications of annual quota agreements.[29] A modified version of the EIAA model was also used for the socio-economic Impact Assessment of the Common Fisheries Policy in 2012, mentioned earlier.[30]

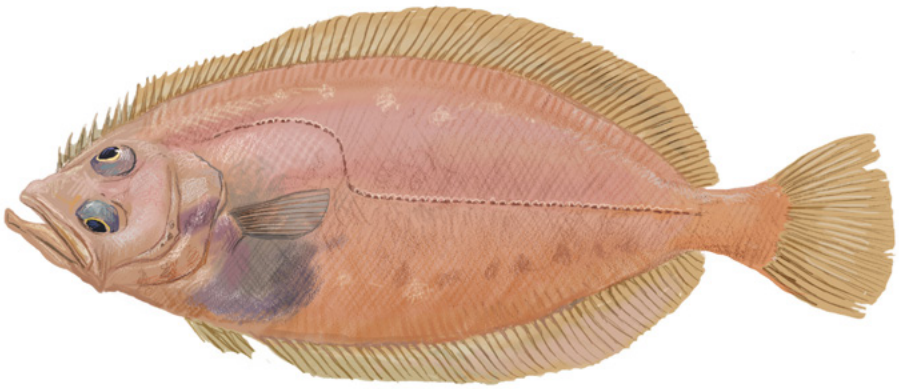
BEMEF takes the EIAA model, adopts its production function and combines several new additions to address specific management questions. Detailed notes on the model can be found in the online documentation.

The great strength of this model structure is that it is built around existing datasets. Of particular importance is the European Commission's Annual Economic Report that records detailed information on the catches, fuel use, employment, fuel costs and a host of other variables at the fleet level. Combing this dataset with information on fish stocks and quotas allows for the impacts of large changes, like reaching MSY, to be analysed at fleet level.

In total, BEMEF covers 221 fleets and 24,526 vessels from 15 countries. The changes to quota and landings are analysed using 150 TACs from 25

main commercial species. This represents approximately 73% of the total landings and 91% of TAC landings. The other 27% of landings are excluded because we have left out fleets with incomplete data or those fishing over half their landings outside the North Atlantic quota areas.

While the full version of BEMEF is Excel-based, a simplified and user-friendly version can be found online at www.fisheriesmodel.eu, where there is also further documentation.



4. Results

Using BEMEF provides new estimates of reaching MSY fisheries in Europe and the impacts of reallocating quota. Results are available at the EU, member state or fleet level.

Economic impacts of reaching MSY

At EU level, the results show an increase in landings from the 2010–2012 base period of three million tonnes in landings and €4.3 billion to an MSY state of five million tonnes and €5.9 billion. Of course the significance of reaching MSY is not in the one-off comparison to current landings; the great benefit comes from the fact that the level of landings can continue indefinitely – something that cannot occur with current levels of biomass and fishing mortality.

Figure 1. Baseline landings and MSY Forecast for BEMEF Fleets

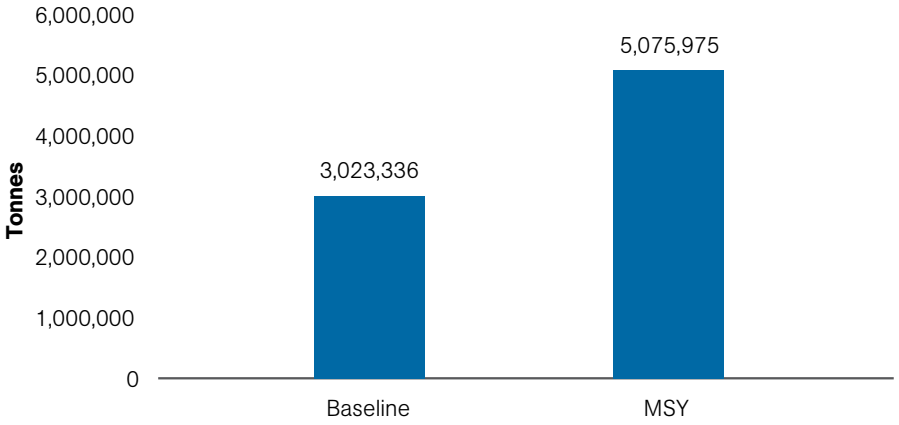
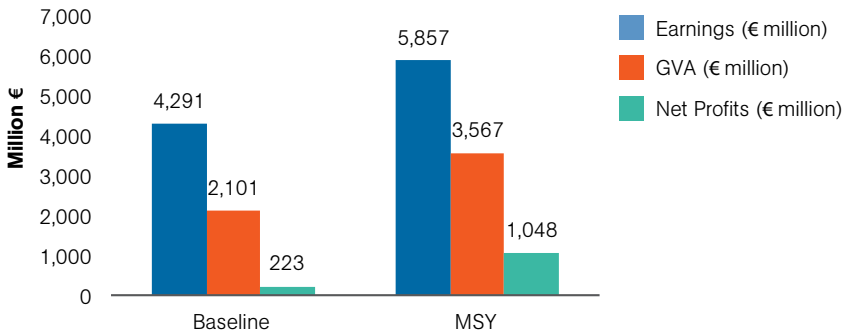


Figure 2. Baseline Economic Outcomes and MSY Forecast for BEMEF Fleets



Similarly, the base period of 56,568 on-board jobs and 33,742 processing jobs increases at MSY to 59,303 jobs at sea and 51,369 jobs in processing. This is a net increase of approximately 20,000 jobs.

Figure 3. Baseline Jobs and MSY Forecast for BEMEF Fleets

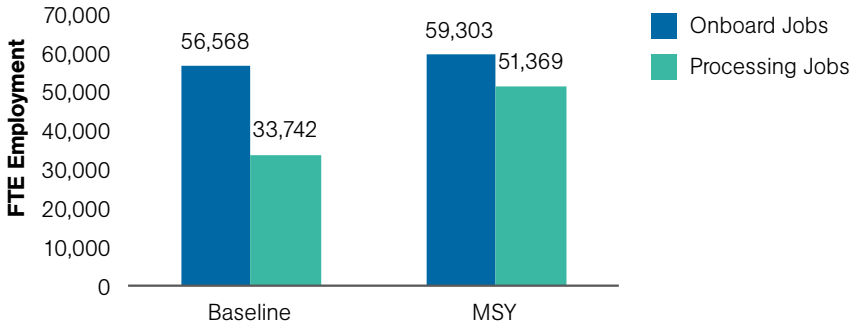


Figure 4. Baseline Wages and MSY Forecast for BEMEF Fleets

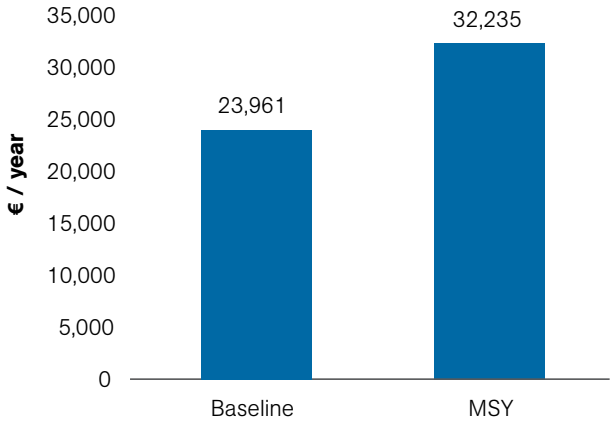
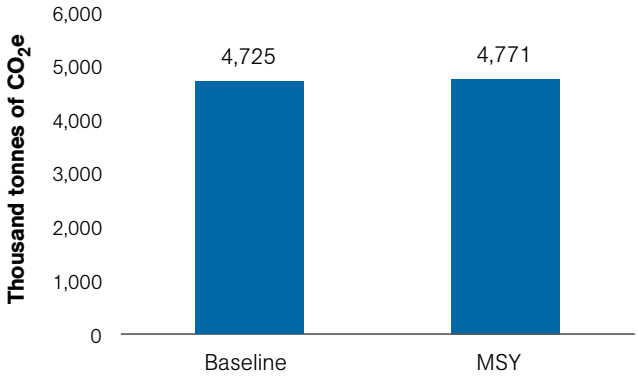


Figure 5. Baseline Carbon Emissions and MSY Forecast for BEMEF Fleets



One important point to note when comparing these estimates to other reports, including those by NEF, is that BEMEF is not modelling all EU waters because the specific analysis here is on just the EU fleet (excluding Norway, Iceland, Russia, etc.). In addition, data limitations prevented some of the European fleets from being analysed in the model, so the overall quantity of the base period and the MSY period are reduced.

Table 2: Summary table of changes from Baseline to MSY

	Baseline	MSY	Difference
Landings (tonnes)	3,023,336	5,075,975	2,052,639
Earnings (€ million)	4,291	5,857	1,565
Gross value added* (€ million)	2,101	3,567	1,466
Net Profits (€ million)	223	1,048	824
Fishing Jobs	56,568	59,303	2,736
Wages (€/year)	23,961	32,235	8,273
Processing Jobs	33,742	51,369	17,626
Carbon (tonnes)	4,725	4,771	46

* Gross value added = depreciation costs + interest + crew share + net profit, or,
Gross value added = Gross revenues - all expenses

The direction of the shift and the relative change are in a similar range to those in earlier reports with a reduced magnitude. This is due to the inclusion of new multispecies MSY estimates, a modelled recruitment effect and price flexibility estimates.[31]

One major methodological change on the processing jobs estimate is that attempts have been made to only include EU jobs. In both the base period and at MSY, any EU processing jobs from importing fish were excluded, as were any non-EU processing jobs from exporting EU fish. These jobs are significant and real, but do not fit the scope of the model. Processing jobs from aquaculture are also excluded from this analysis in order to isolate the impact of changes to quota levels.

Economic impacts of reallocating quota

While the default assumption in BEMEF is to allocate quotas within a country based on historic share, this assumption can be modified to analyse some options for allocating quota based on socio-economic criteria. As the Annual Economic Report dataset reports a number of metrics by the fleets analysed, four alternative scenarios were derived from this data source:

- allocating quota based on fuel minimisation – kilogrammes (kg) of landings per litre of fuel
- effort minimisation – kg of landings per kilowatt (kw) of engine power
- job maximisation – full-time employment per kg of landings
- and profit maximisation – net profit minus subsidies per kg of landings.

In these alternative quota allocation scenarios, fleets are assessed on their performance on the scenario criteria over the 2010–12 base period. Then – within a country, for a certain species and area – quota is allocated proportionately, based on previous performance.

The results show that using alternative criteria for quota allocation can have large impacts across socio-economic measures. For example, the reduction in carbon emissions is highest under the 'fuel minimisation' scenario. The increase in on-board jobs is greater under the 'job maximisation' scenario.

Other results suggest that different allocations can have an impact on gross earnings and gross value-added, as some fleets receive a higher price at port for their catch – a finding that is strong from the 'job maximisation' scenario. The 'effort minimisation' scenario tends to result in reducing the industry to a few large vessels thereby reducing the number of jobs from the 'historic share' scenario.

The graphs below show that there are trade-offs involved and, to a large extent, the best 'quota allocation' scenario depends on the specific

Figure 6. Net Change in Economic Outcomes of Quota Allocation Scenarios at MSY

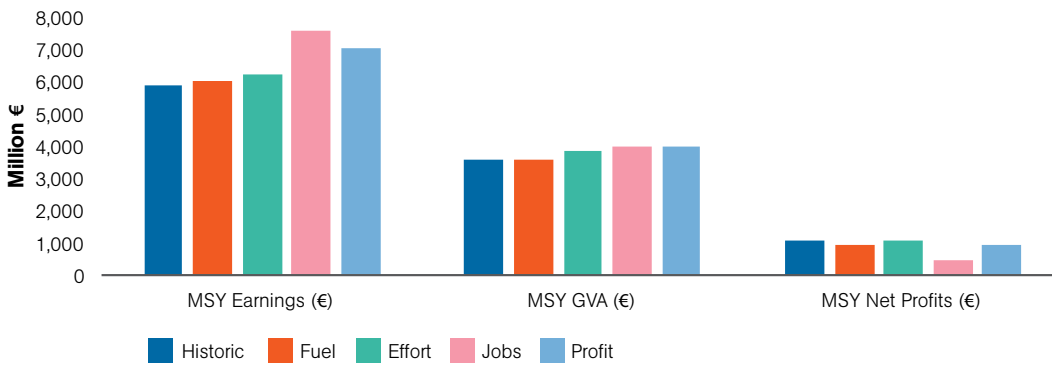


Figure 7. Net Change in Wages from Quota Allocation Scenarios at MSY

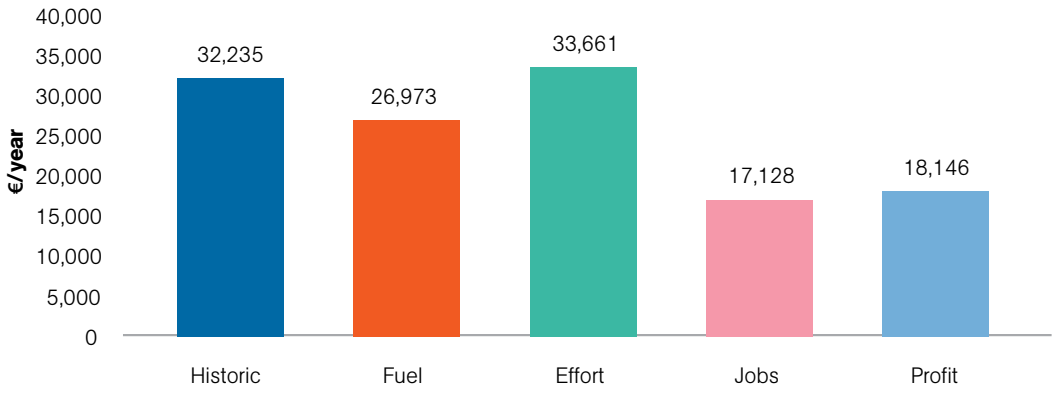


Figure 8. Net Change in Carbon Emsissions of Quota Allocation Scenarios at MSY

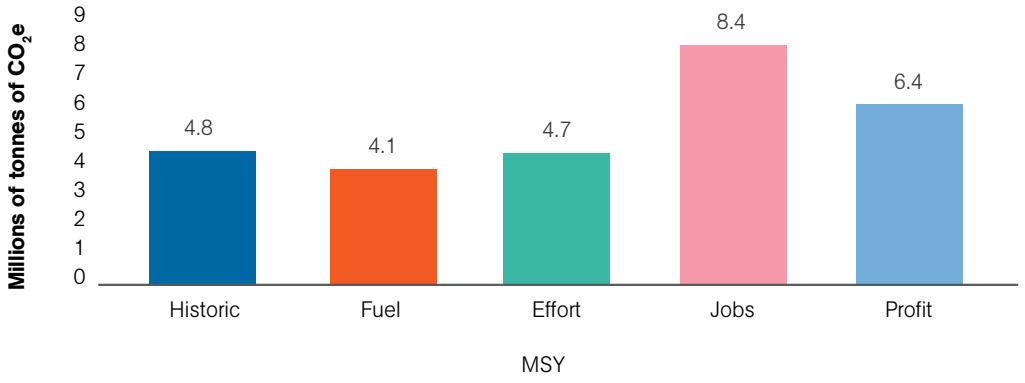
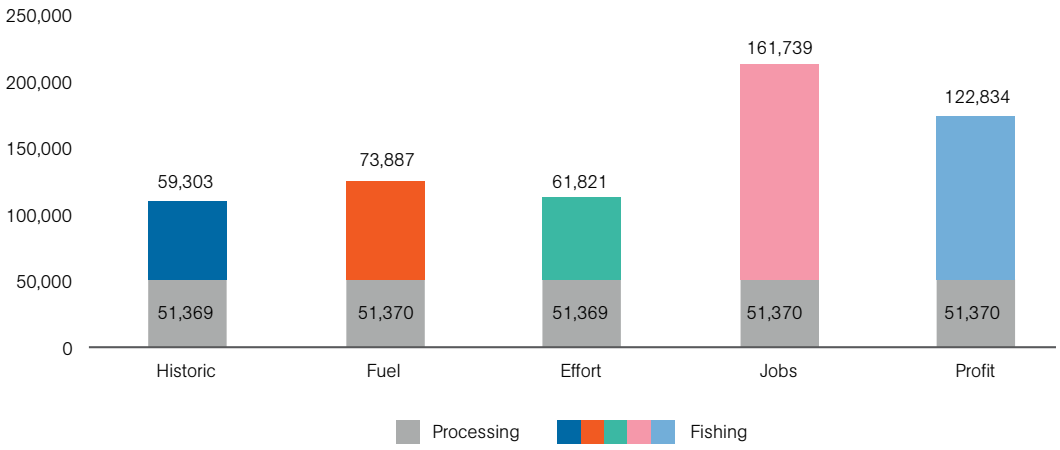


Figure 9. Net Change in Jobs from Quota Allocation at MSY



outcome that is being targeted.

Breaking down the results – national perspectives

At a country and at a fleet level the benefits of reaching MSY are not evenly distributed. Some stocks will have an increased yield while those that are in the early stages of over-exploitation will see a decline in yield at MSY.

At member state level, the large beneficiaries in BEMEF are Denmark, the UK, Netherlands, France and Ireland. This is because they have the largest share of the TACs and landings of quota species – in particular those species which are expected to greatly increase at MSY.

Some counterintuitive results are present in the results, such as a decrease in MSY landings for Finland. It is important to note that it is entirely possible that MSY, as a sustainable yield into the future could be less than baseline landings that are not sustainable. This could be

Figure 10. Baseline Landings and MSY Forecast for BEMEF Fleets

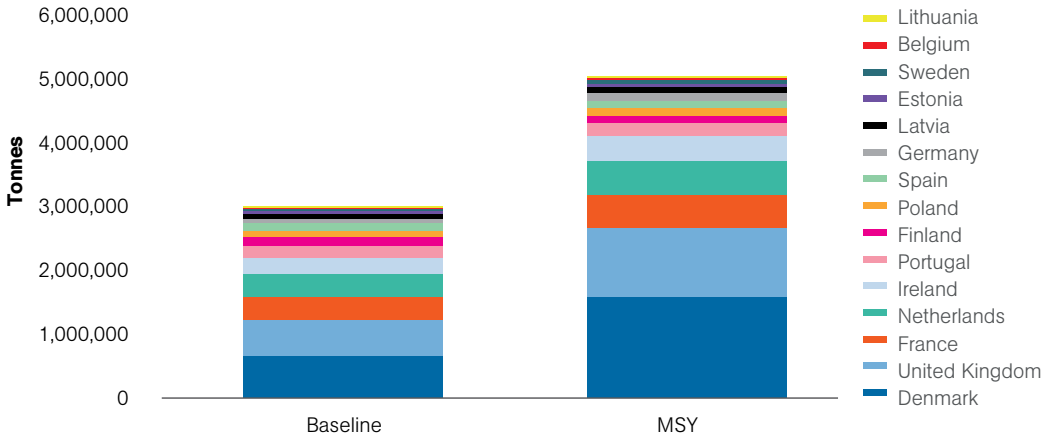


Figure 11. Baseline Earnings and MSY Forecast for BEMEF Fleets

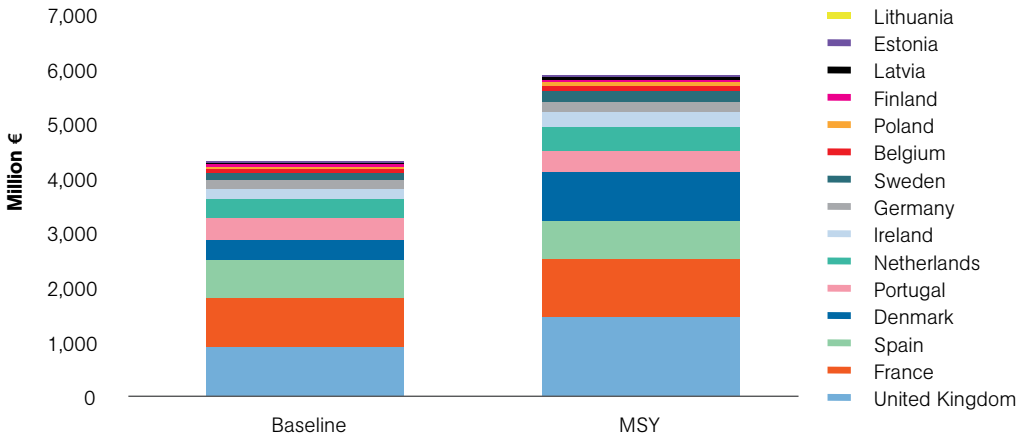
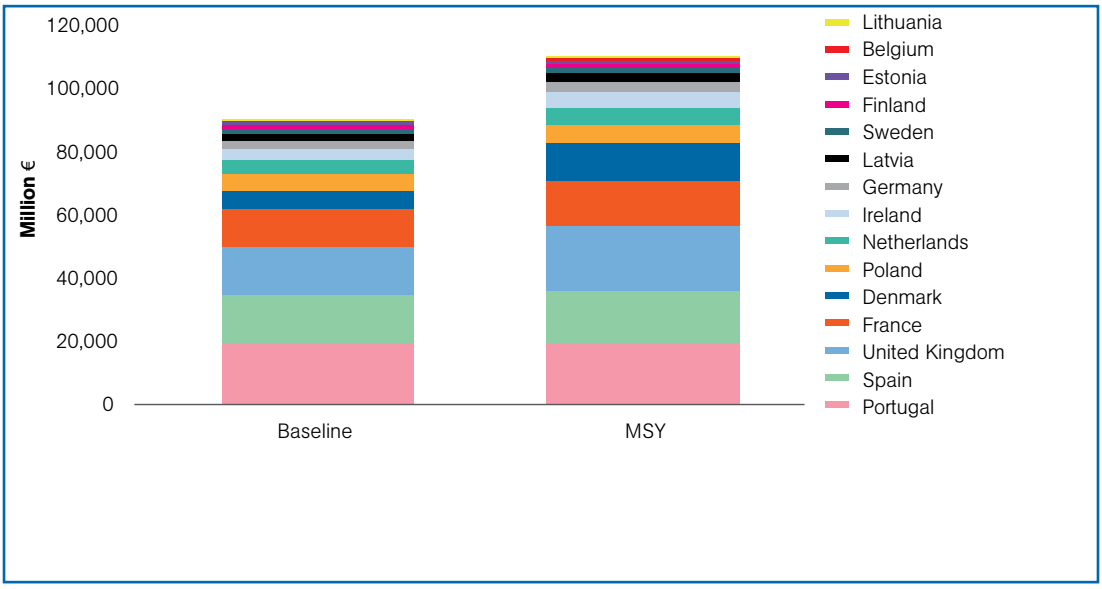


Figure 12. Baseline Jobs and MSY Forecast for BEMEF Fleets



evidence of overfishing or alternatively outcome of crude techniques to estimate MSY based on previous landings of a stock in dramatic recovery. In the case of Finland, some key stocks such as herring in the Bothnian Sea and Bothnian Bay have seen recovery and associated increases in landings. This trend is likely distorting the benefits of MSY, although it is equally true that the increased landings in the baseline are reducing the premium at MSY in reality.

For earnings the same countries also benefit the most, as Member States like Spain and Portugal have large but stagnant earnings as their main stocks are not covered in BEMEF.

The general trend for countries differs in the case MSY employment due to the significant differences in industry structure between countries. The high job intensity of the Spanish fleet converts a small increase in fleet landings into a proportionally larger increase in jobs. The opposite trend is found in the Danish industry. The inclusion of processing jobs moderates some of this effect as there is a more uniform relationship between landing size and employment across national industries.

These job estimates, particularly those for fishing jobs are conservative as they are based on effort-approach that adjusts the employment required for additional landings but also a reduction in required employment as catchability increases at MSY. Wage-based estimates of jobs, that is, how much employment would be attracted to the industry, show a much greater estimate of jobs as earnings increase.

The results presented here may differ from those of the found in the electronic versions of the model as we hope to continue to improve the model through feedback on methodology and updated datasets.

5. Discussion

There are many modelling considerations behind BEMEF. A continued discussion of approaches the bio-economic modelling of fisheries can improve robustness and open up new areas for analysis.

Coverage

The results here are limited in their application to all EU fisheries as not all species are modelled in BEMEF. The model is designed primarily as a tool to analyse commercially fished species under quota management. Not only are these species of particular socio-economic interest, they have also received the most research and attention.

Because of this focus, there are smaller changes in BEMEF to fleets that primarily target non-quota species. While it is not specifically analysed in BEMEF, there are likely to be similar impacts of MSY as stock assessments of non-quota species show similar patterns of low biomass and high mortality.[32,33, 34]

Not all fleets are modelled in BEMEF. As the model has significant data requirements, around 65% of the fleets could not be analysed. These fleets have poor data reporting and tend to be small-scale fleets. As a percentage of landings, BEMEF models 73% of the fishing by EU fleets.

It is worth noting that the impact assessment for the Common Fisheries Policy contained 50 fleets. This improvement in coverage largely concerns better data reporting in the few years since the assessment.

Key parameters

Some key parameters – such as price flexibilities, fuel cost, technological change and job calculations – can be set by the user of BEMEF. For the results above price flexibilities were set based on a literature review and jobs were estimated using an effort-based approach that calculates the number of days at sea required to catch a given level of landings from the estimated biomass.

Fuel price and technological change were removed from this comparison but are available in the model. The comparison in this report is between a historic and potential state, rather than a time-dependent analysis where these future projections are important and can be specified.

Interested users are welcomed and encouraged to change the model parameters for their own analysis using BEMEF.

One approach that shows some promise is the use of a focused biological model of fisheries, like the Fisheries Libraries in R (FLR) model. Here the biological results for each year are fed into the model, as spawning stock biomass and TACs follow a certain recovery path. This approach may be explored in a future version of the model.

Practicality of reallocating quota

The quota allocation scenarios should not be seen as a policy proposal. In reality quota allocation will take into account historic share to maintain some stability in the industry. It is also best to use a suite of indicators together, rather than one indicator in isolation. But, as this important issue has not been analysed in depth before, the type of economic analysis BEMEF provides can move the discussion forward.

There are also questions about how much quotas can shift, given the capacity (current or future) of different fleets. In the model we have not analysed the issue of pinning down the number of quotas than can be shifted. However, it is important to note that, given the very small quotas currently allocated to some fleets (mainly smaller, inshore vessels) even a small change creates a significant marginal increase.

In part to address capacity issues, BEMEF calculates where fleets historically fish, and what species they land at port, before allocating quota. Only fleets that currently fish within the same quota area are compared on the different indicators used. Fleets that land less than 100 kg of a species were not considered for this comparison. The consequence of these requirements is that quotas for deep water fishing are only available to the large vessels that currently operate in this fishery. We are reviewing adjusting the threshold for current landings to better match the realities of fleet capacity and gear type.

MSY estimates

There has been, and will continue to be, debate among fisheries scientists as to the most reliable way of calculating MSY. For BEMEF a hierarchy of data sources is used as there are many estimates for the same stock. The first set of estimates is from multispecies studies where ecosystem dynamics have been taken into account. The next set of estimates comes from single stock analysis in the academic literature. Another set of estimates comes from the original EIAA model.

Although dated, MSY estimates should theoretically remain the same. Finally, for any stocks without estimates, the MSY estimate was set at the base period TAC.

Where a comparison could be made, the final set of MSY estimates was plotted against historical catch data to ensure estimates were within a reasonable range. In addition, where there was overlap between sources there tended to be similar estimates, including those from multispecies methods.

Transition period

While BEMEF presents a new framework that pulls together several work areas in fisheries management, there are still several key areas that are not contained in this version of the model. First and foremost is the transition period. BEMEF presents where we were in the baseline; where we are now (modelled based on quota); and where we could be with sustainable fisheries. How the transition could take place between these time periods and the MSY time period requires the modelling of complex year-on-year relationships between fishing pressure, market factors, ecosystem dynamics, stock abundance and industry changes.

6. Conclusion and next steps

There is an evidence base for strong action on reaching MSY fisheries in the EU and for allocating quota based on performance. The policy mechanisms are also available, and in many cases, legally required.

The results of our research strengthen the economic case for rebuilding EU fish stocks to beyond MSY and identify opportunities to generate additional economic benefits through reallocation of fish quotas across the fleet. They demonstrate that – besides the legal requirements of the CFP – there is a strong incentive for member states to take action to get fish stocks to MSY and allocate quotas to parts of the fleet that deliver highest value to society.

That rebuilding fish stocks can deliver economic benefits is not a new finding in itself. The longer we keep fish stocks below MSY, the longer we will be missing opportunities in terms of food, profits and jobs. Long-term gains outweigh the transition costs, but the latter represent a barrier to political action. The challenge for member states is to identify ways to make this transition as soon as possible, while ensuring the fishing fleet and industry continues to operate and can benefit once fish stocks are restored.

The potential for additional economic benefits from different quota allocation scenarios constitutes a new finding. It is new territory for member states and an area that they are not very familiar with. Member states clearly need to investigate this further, as required by Article 17 of the Common Fisheries Policy.

To make the most of this opportunity, we outline three key actions that member states must follow:

- ensure that agreements on fishing limits do not exceed scientific advice
- identify opportunities at national and regional level to test and put into practice new ways of allocating quota across the fleet
- make use of the European Maritime and Fisheries Fund (EMFF) – the financial vehicle to support the implementation of the Common Fisheries Policy – to improve data collection on the state of fish stocks and performance of the fleet.

The BEMEF model can guide member states on this journey by providing an overview of the potential benefits and impacts at stake. But it will need to be further developed if it is to be more practical at policy implementation level.

Going forward we aim to focus on three key areas for the future development of the BEMEF model:

- making the model dynamic: modelling the transition to beyond MSY
- ensuring the model captures the national reality of each member state beyond what is revealed in the official data
- expanding the scope of the model to incorporate non-quota species and the Mediterranean region.

Appendix

As the model continues to evolve, BEMEF documentation notes can be found at www.fisheriesmodel.eu

Table A1. Baseline Landings and MSY Projection for BEMEF Fleets

Country	Baseline (tonnes)	MSY (tonnes)	Change (tonnes)
Denmark	677,493	1,599,160	921,667
United Kingdom	564,646	1,114,170	549,524
France	374,151	510,364	136,213
Netherlands	357,002	520,673	163,672
Ireland	247,409	403,817	156,408
Portugal	203,313	205,929	2,615
Finland	124,894	118,225	-6,669
Poland	113,535	117,207	3,673
Spain	102,725	114,417	11,692
Germany	81,096	121,170	40,074
Latvia	64,870	90,089	25,219
Estonia	46,814	47,972	1,158
Sweden	41,672	77,685	36,013
Belgium	20,408	26,816	6,408
Lithuania	3,310	8,280	4,970

Table A2. Baseline Earnings and MSY Projection for BEMEF Fleets

Country	Baseline (€ million)	MSY (€ million)	Change (€ million)
United Kingdom	918	1,464	546
France	900	1,056	156
Spain	678	709	32
Denmark	395	903	508
Portugal	373	360	-14
Netherlands	359	457	98
Ireland	192	263	72
Germany	140	184	44
Sweden	134	210	76
Belgium	81	93	12
Poland	47	63	16
Finland	36	35	-1
Latvia	23	38	15
Estonia	10	10	1
Lithuania	5	10	5

Endnotes

1 European Commission. (2015, 2 March). *The Common Fisheries Policy*. Retrieved from http://ec.europa.eu/fisheries/cfp/index_en.htm

2 There is increasing recognition that MSY is a limit rather than a target, see http://www.europarl.europa.eu/committees/en/pech/events.html?id=20150123CHE00161

3 European Commission. (2015, 2 March). *The Common Fisheries Policy. Retrieved from* http://ec.europa.eu/fisheries/cfp/index_en.htm

4 European Union/Eur-Lex. (n.d.). *Communication from the Commission to the European Parliament and the Council. Retrieved from* http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2014:388:FIN

5 European Commission. (2014). Communication from the Commission to the European Parliament and the Council Concerning a consultation on Fishing Opportunities for 2015 under the Common Fisheries Policy. COM(2014) 388 http://ec.europa.eu/dgs/maritimeaffairs_fisheries/consultations/fishing-opportunities-2015/doc/com-2014-388_en.pdf

6 European Commission. (2014). Communication from the Commission to the European Parliament and the Council Concerning a consultation on Fishing Opportunities for 2015 under the Common Fisheries Policy. COM(2014) 388 http://ec.europa.eu/dgs/maritimeaffairs_fisheries/consultations/fishing-opportunities-2015/doc/com-2014-388_en.pdf

7 Carpenter, G. & Esteban, A. (2013, 10 October). *Unknown Waters. New Economics Foundation.* http://www.neweconomics.org/publications/entry/unknown-waters

8 European Commission. (2014). Fishing TACs and Quotas 2014. http://ec.europa.eu/fisheries/documentation/publications/poster_tac2014_en.pdf

9 Negotiations must also be made for some TACs with non-EU countries including Norway, Russia and the Faroe Islands.

10 European Commission. (2014, 28 October). *Proposal for a Council regulation fixing for 2015 the fishing opportunities for certain fish stocks and groups of fish stocks, applicable in Union waters and, for Union vessels, in certain non-Union waters and repealing Council Regulation (EU) No 779/2014. Retrieved from* http://ec.europa.eu/fisheries/cfp/fishing_rules/tacs/info/com_2014_670_en.pdf

11 European Commission. (2014). Communication from the Commission to the European Parliament and the Council Concerning a consultation on Fishing Opportunities for 2015 under the Common Fisheries Policy. COM(2014) 388 http://ec.europa.eu/dgs/maritimeaffairs_fisheries/consultations/fishing-opportunities-2015/doc/com-2014-388_en.pdf

12 Seafish. (2014). Seafish summary 2014 TACs compared with ICES scientific advice. http://www.seafish.org/media/publications/Seafish_AnalysisTACs2014_201404.pdf

13 Esteban, A. & Carpenter, G. (2014, 31 October). *Landing the blame: Overfishing in the Baltic Sea. New Economics Foundation. Retrieved from* http://www.neweconomics.org/publications/entry/landing-the-blame-overfishing-in-the-baltic-sea

14 Esteban, A. & Carpenter, G. (2014, 31 October). *Landing the blame: Overfishing in the Baltic Sea. New Economics Foundation. Retrieved from* http://www.neweconomics.org/publications/entry/landing-the-blame-overfishing-in-the-baltic-sea

15 The Pew Charitable Trusts. (2014, 28 October). *European Commission proposes 2015 fishing limits: Fisheries ministers should end overfishing without delay. Retrieved from* http://www.pewtrusts.org/en/about/news-room/news/2014/10/28/european-commission-proposes-2015-fishing-limits

16 The Scottish Government. (2015, 17 February). Negotiations and t*otal allowable catch. Retrieved from* http://www.scotland.gov.uk/Topics/marine/marine-environment/species/fish/TAC

17 European Commission. (n.d.). *How we manage our fisheries*. Retrieved from http://ec.europa.eu/fisheries/documentation/publications/cfp_brochure/how-we-manage-our-fisheries_en.pdf

18 European Commission. (2015, 2 February). *TACs and quotas. Retrieved from* http://ec.europa.eu/fisheries/cfp/fishing_rules/tacs/index_en.htm

19 Marine Management Organisation. (2013). *UK Sea Fisheries Statistics. Retrieved from* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/358342/UK_Sea_Fisheries_Statistics_2013_online_version.pdf

20 This is a NEF calculation using Marine Management Organisation statistics. Marine Management Organisation. (2015, 26 February). *Quota Use Statistics. Retrieved from* https://www.gov.uk/government/statistical-data-sets/quota-use-statistics

21 Grieve, G. (2009). Environmental and Social Criteria for Allocating Access to Fisheries Resources. Meridian Prime. http://ec.europa.eu/fisheries/reform/docs/pew_annex1_en.pdf

22 Crilly, R. & Esteban, A. (2013). Small versus large-scale, multi-fleet fisheries: The case for economic, social and environmental access criteria in European fisheries. Marine Policy 37, pg. 20-27. http://www.sciencedirect.com/science/article/pii/S0308597X12000875

23 Newman, S. (2014), Practical implementation of Article 17 of the CFP. Institute for European Environmental Policy. http://www.ieep.eu/assets/1664/IEEP_2014_Practical_implementation_of_CFP_Art_17.pdf

24 Crilly, R. & Esteban, A. (2012). *No Catch Investment. New Economics Foundation. Retrieved from* http://www.neweconomics.org/publications/entry/no-catch-investment

25 Agnew, D. et al., (2010). Environmental, Economic, Social and Governance impacts of the 2012 CFP revision. http://ec.europa.eu/fisheries/documentation/studies/impact_assessment_phase_ii/phase_ii_final_report_en.pdf

26 Crilly, R. & Esteban, A. (2012). Jobs Lost at Sea. New Economics Foundation. http://www.neweconomics.org/publications/entry/jobs-lost-at-sea

27 ACFM is the Advisory Committee for Fisheries Management and operated within ICES.

28 Frost, H., Andersen, J., Hoff, A., Thøgersen, T., (2009). *The EIAA model*. University of Copenhagen. Retrieved from http://ifro.ku.dk/english/staff/?pure=files%2F44693774%2FReport_200.pdf/

29 Anderson, J. & Carvalho, N. (2013). *The 2013 annual economic report on the EU fishing fleet.* STECF. Retrieved from http://stecf.jrc.ec.europa.eu/documents/43805/581354/2013-09_STECF+13-15+-+AER+EU+Fleet+2013_JRC84745.pdf

30 Agnew, D., MacFadyen, G., Caillart, B., Lutchman, I., Triantaphyllidis, G., Arthur, R., Leotte, F., Calvo, C., Cappell, R., Davies, T., Edwards, C., Harris, C., Peatman, T. & Accadia, P. (2010). *Environmental, economic, social and governance impacts of the 2012 CFP revision.* Retrieved from http://ec.europa.eu/fisheries/documentation/studies/impact_assessment_phase_ii/phase_ii_final_report_en.pdf

31 This inclusion of price flexibilities would be likely to bring down transition costs as having fewer fish on the market during the transition would fetch a higher price.

32 Centre for Environment, Fisheries & Aquaculture Science. (2011). *English Stock Assessments by species and area.* Retrieved from http://www.cefas.defra.gov.uk/our-science/fisheries-information/commercial-species/shellfish.aspx

33 International Council for Exploration of the Sea. (2014). *Advice June 2014 for Celtic Sea and West of Scotland + North Sea European sea bass in Divisions IVbc, VIIa, and VIId-h (Irish Sea, Celtic Sea, English Channel, and southern North Sea). Retrieved from* http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2014/2014/bss-47.pdf

34 Eftec. (2015). *The Economic Case for Investment in Natural Capital in England: Marine Appendix. Retrieved from* https://nebula.wsimg.com/2fd9d1a8a42128eb4c8f7cd3f8c8c2c8?AccessKeyId=68F83A8E994328D64D3D&disposition=0&alloworigin=1

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