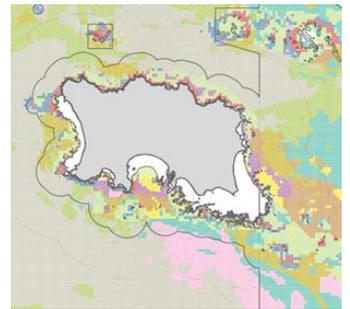


Feasibility of a low impact fisheries model in Jersey - Final Report

REPORT FOR BLUE MARINE FOUNDATION



MacAlister Elliott & Partners Limited
56 High Street, Lyngton, Hampshire, SO41 9AH, England
www.macalister-elliott.com

Document Information

Project Number:	3299
QA Number:	3299R02B
Report Title:	Feasibility of a low impact fisheries model in Jersey - Final Report
Author(s)	MEP
Date:	07 April 2022

Table of Contents

Project overview.....	4
1. Summary of the costs and benefits of implementing a static gear only Marine Park.....	7
2. Potential low impact fishery options for Jersey	10
2.1 Seabed impact.....	11
2.2 Target stock population.....	13
2.2.1 Access rights	13
2.2.2 Quota.....	15
2.2.3 Technical measures.....	15
2.2.4 Improving science and data	15
2.2.5 Supply chain	16
2.3 Bycatch and discards.....	20
2.4 Plastic and pollution	21
2.5 Carbon emissions	22
2.6 Fish welfare	23
2.7 Other impacts	24
2.7.1 Bait digging.....	24
2.7.2 Impacts on endangered species	24
2.7.3 Social impact	24
Table 1: Proposed low impact fisheries options in Jersey	26
3. Conclusions	34
4. References	37

Table of Tables

Table 1: Proposed low impact fisheries options in Jersey	26
--	----

Project overview

Commercial fisheries in Jersey play an important role in the daily life and economy of the island and remain an important fishing ground for French vessels, despite changes in access under the new EU-UK Trade and Cooperation Agreement (TCA). The territorial waters around Jersey therefore have the potential to be subject to intense fishing activity. Currently 6.5% of Jersey's territorial waters (and more specifically a proportion of the island's key identified OSPAR habitats, for example the majority of Jersey's seagrass beds and around 15% of maerl beds) are currently protected from mobile fishing gear (principally trawling and dredging), yet this still falls short of the 10% suggested by the Convention on Biological Diversity and the 30% by 2030 as outlined by Global Ocean Alliance and High Ambition Coalition. Several parties, including the Blue Marine Foundation (herein referred to as BLUE), are making the case for further expansion of Jersey's protected marine zones which may include a Marine Park around some of the island that could exclude mobile fishing gears, such as trawling and dredging¹.

Closing off designated areas of the sea to specific fishing activities is just one element of marine environmental protection. To go further, a more holistic approach is required such as the implementation of a 'low impact' fisheries model. Through working with key stakeholders, BLUE intend to deliver such a model for Jersey.

What constitutes 'low impact' is not currently well defined, similarly neither is the definition of what constitutes a low impact fisheries model, so there is a need in the UK fisheries sector to identify objective, transparent and workable low impact fishing criteria. The Countryside and Community Research Institute (CCRI) worked with the New Economics Foundation (NEF), Marine Resources Assessment Group (MRAG) and the Centre for Environment, Fisheries and Aquaculture Science (Cefas) in 2019-2020 on a project for Defra that sought to co-design, with fisheries stakeholders, principles that can be used to define low impact fishing². It is on these key principles that the components of a low impact fisheries model have been based around for this consultancy project, as it is the most recent work available on the topic³.

A low impact fisheries model for Jersey may combine several aspects, including: seabed habitat protection through protected areas; sustainable stock management through flexible catch allowances and codes of conduct; use of selective fishing gears; lowering fleet carbon emissions; reducing plastic use and waste; minimising negative social impact and improving fish welfare.

Low impact fishing is therefore a broad term and for every type of fishing activity (e.g. whether it is static or mobile) each of the above components must be fully assessed before an activity is defined as low impact. Static fishing is commonly assumed to be lower impact than mobile fishing, although uncontrolled fishing effort and intense fishing activity over short fishing seasons could feasibly cause significant ecosystem damage.

¹ A ban of all mobile gear in the zone is proposed by BLUE at this stage, but it is likely that this may be revised to just consider demersal mobile gear given the generally reduced impacts of pelagic vs demersal gears.

² <http://scienceresearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=20408> ; <http://www.ccri.ac.uk/lowimpactfishing/>

³ Since the low impact fishing report <http://www.ccri.ac.uk/lowimpactfishing/> was delivered to Defra, it is unknown if, how or when Defra plan to operationalise the criteria (personal communication with Chris Williams, NEF, October 2021).

In 2012 in Lyme Bay, UK, BLUE and local stakeholders supported an existing collaborative fisheries model by bringing together fishers, conservationists, researchers and regulators to manage the Lyme Bay Fisheries and Conservation Reserve. This is the key UK example of a model where aspects of 'low impact' fishing is considered holistically. Elements of the Lyme Bay model have been reviewed in the context of Jersey, such as supporting and incentivising small-scale fishers to manage their catches within sustainable limits. Incentivising and achieving buy-in from fishers is key to the success and longevity of low impact management frameworks, so it is important that as far as possible, the negative impact on fisher livelihoods is reduced or mitigated for those expected to be hit hardest by changes to the legislative or management framework. This might include financial support for fishers to mitigate their losses (e.g. diversification of fishing using altered gears or different fishing grounds) and / or careful incorporation of sufficient value addition into the low impact model.

The components of a low impact fisheries model described above will of course require some legislative change and adaptation of the fishery. Before decisions on implementing associated management measures can be made, a sound evidence base to support the objectives is required. In general terms, there should be consideration of the scale of economic impacts to fishing businesses versus the potential benefit gained from protecting marine habitats, which in turn provide ecosystem services to Jersey citizens.

There exists a real opportunity for Jersey to develop a collaborative low impact fisheries model. The commercial fishery is already primarily a day boat, small-scale, static gear fishery, that subject to some tighter effort controls and stock protection, already meets many of the criteria of low impact fishing. In addition to this, under the new TCA, Jersey can have more control over future French access to and fishing effort within the Jersey zone than under the previous Granville Bay Agreement (GBA), although is dependent on a new licensing system for the whole fishery, yet to be finalised by Jersey Government.

This consultancy project aims to provide the first step in enhancing the evidence base for implementing a low impact model in Jersey. MacAlister Elliott and Partners (MEP) were contracted by BLUE to complete several tasks that contribute to this objective. The overall aim of the project was:

To assess the opportunities and constraints of implementing a 'low impact model' for Jersey's commercial fisheries, a part of which incorporates a static gear only Marine Park.

Specific tasks included:

1. Summary of the commercial fisheries in Jersey's waters
2. Cost benefit analysis of switching to static gear only fisheries within the proposed Marine Park
3. Review of the mechanisms available, and recommendations on how to deliver a low impact fisheries model for Jersey
4. A review of options for Jersey eco-labelling for sustainable fisheries and other added value opportunities

This Final Report summarises the results of the cost benefit analysis (based on a standalone report submitted separately to BLUE for Tasks 1 & 2) and an assessment of various low impact fishery options for Jersey for Tasks 3 and 4, based on the components defined in the Williams et al., (2020) report. Although the pros and cons of implementing various low impact options

has been assessed, a full feasibility assessment has not been completed as part of this work. This is because feedback from key stakeholder groups is first required to check the correct fisheries issues have been identified for Jersey, and to test the identified benefits and disadvantages for each associated low impact option with the fishing industry and other key stakeholders. Based on discussions between MEP and BLUE, it was decided not to obtain such feedback as part of this project due to the timing coinciding with complex EU licencing negotiations. BLUE subsequently intend to continue this consultation and feedback process at a later date, which may require further MEP support under another contract.

1. Summary of the costs and benefits of implementing a static gear only Marine Park

A detailed standalone technical report has been submitted to BLUE that supports this summary section. MEP were asked by BLUE to assess the impact of implementing a static gear only Marine Park occupying approximately 900km² of Jersey's waters. To do this, MEP conducted a Cost Benefit Analysis (CBA) employing a natural capital approach, which incorporated both quantitative and qualitative assessments of cost-benefit to the fishing industry, the government, and the ecosystem. The structure of the assessment is a simplified version of the template used by the UK Government when conducting a CBA on implementing similar fisheries regulations.

A CBA which employs a natural capital approach, alongside a more traditional economic impact assessment should be considered essential in the formulation of management strategies that aim to meet complex social, environmental and economic objectives. In doing so, the likely extent and quality of supporting, regulatory, provisioning and cultural ecosystem services can be taken into account and so the goods/benefits provided for society become an inherent feature of future management decision-making processes.

The below CBA assumes the immediate implementation of a static gear only Marine Park.

In summary, 'cost' was assessed by a combination of the following:

- The gross loss (unmitigated) to the fishing industry of the closure (£/€)
- The net change in income from Jersey active gears assuming mitigation (£)
- The cost to government of enforcing the closure (£)

In summary, 'benefit' was assessed by a combination of the following:

- Additional resources previously fished by mobile gears available for static gears in the Marine Park (£)
- Increased area available for static gears by avoiding gear conflicts (£)
- Benefits from protecting Natural Capital from mobile gears in the Marine Park (qualitative)

It is important to note that for Natural Capital benefits, although MEP were able to monetise some ecosystem services (due to available studies providing usable figures), for others this was not possible, so an overall benefit in £GBP has not been generated and is purposefully not used to adjust overall 'benefit' figures.

This CBA is mainly concerned with the impacts on Jersey vessels because we are aiming to quantify the economic consequences for Jersey. However, the Marine Park will also have an impact on the French fishery, and the gross cost of this was evaluated for reference. As far as we know at present, however, the economic loss to the French mobile fleet has no economic implications for Jersey, so this cost only intervenes in the analysis relating to Jersey to the extent that it makes additional resources available for static/passive gears and requires resources for enforcement. There may be additional consequences for Jersey from excluding the French mobile gear fleet, depending on licensing under the TCA but these were not known to MEP at the time of writing.

Using data provided by the Government of Jersey and comparative studies in the literature, the **minimum total economic cost** to the Jersey fisheries sector (collectively considering cost benefit to fishers and government) of implementing the Marine Park was estimated to be **~£7,300**.

As above, the assessment considers: the net loss of income from Jersey mobile fleet (assuming a proportion of mitigation by the mobile fleet either to alternative fishing grounds and/or switching gears); the gain to the Jersey static fleet from additional scallop resources; a reduction in gear conflicts/loss; and the cost to government of enforcing the closure.

It is important to note that the cost presented is considered a *minimum impact*, as first sale values are utilised in income loss calculations so for the fishing fleet, it represents the loss in immediate first sale income, without considering potential gains and losses in downstream supply chains where value additions occur. Calculating the latter would require a standalone assessment and a different evidence base.

When looking at the impact to the whole Jersey fishing fleet (static and mobile fishers combined), the minimum loss of income to the mobile gear sector (£66,200) was estimated to be offset by the gain in scallops and reduced loss of potting gear (£68,900). Impacts will of course be felt differently by individual businesses. For example, mobile fishers will be less impacted if they can mitigate by moving to alternative fishing grounds, or by diversifying to static gears. Those who are not able to mitigate may qualify for compensation. Potential compensation costs have not been included in the overall impact assessment as this is beyond the scope of the project.

The £7,300 cost to the sector represents a direct monetised value deemed from fisheries economic data modelled and provided by the Government of Jersey. However, our cost-benefit assessment also incorporates an assessment of Natural Capital (a type of benefit), which is a standard analytical approach to evaluating the role and value of nature to society and thereby to support decision making and to inform policy. The beneficial flows which stem from the Natural Capital stocks are termed 'ecosystem services', and they supply a public need covering economic, social, environmental, cultural, or spiritual benefits. How the value of these goods/benefits is described can be qualitative or quantitative (including monetary). The evidence base to support valuation of the ecosystem services associated with specific marine habitats is unfortunately limited (and currently limits people's confidence in their application) but where we have been able to find studies that assign monetary value to various ecosystem services, we have calculated this for Jersey's habitats in the Marine Park area.

In this assessment we have monetised benefits from carbon sequestration potential, and kelp habitat. As we have not been able to monetise all relevant ecosystem services, and the assessments take very different approaches, the Natural Capital (carbon and kelp) monetised values do not affect the £7,300 obtained during the fisheries data assessment.

The Natural Capital assessment of benefit has concluded that protected marine habitats within the proposed Marine Park could be associated with a monetised value of around **£1.3 million** based on traded carbon values. Other benefits associated with kelp, such as protection of coastlines from erosion, harvesting potential and nursery habitats for commercial species have been valued at around **£5.8 million**. These numbers do not take into consideration a natural capital assessment (with exception of carbon sequestration estimates) of other habitat types (beyond kelp) that would be protected following designation of a Marine Park, including

the provision of additional fishery resources beyond scallops⁴. This illustrates that the wider benefits of protecting an area of Jersey's marine environment from the most damaging activities are likely to be considerable over time.

Based on the initial evidence presented, at this stage, it is considered that the environmental, societal, and economic benefits of introducing the proposed management, outweigh the potential monitoring, administrative and enforcement burden and costs to industry. However, given the numerous components that need to be considered for low impact fishing, the implementation of such a management measure would need to be weighed up in terms of cost benefit and priority against other measures (given likely funding limitations), but also in terms of coherence with other measures. As discussed below, a combination of measures, implemented and timed correctly, are likely to be more effective in achieving conservation objectives and stakeholder buy-in. Some management measures will of course be more easily implemented than others.

Finally, it is important to highlight here the limitations of the CBA as publication of this analysis is likely to generate a certain level of scrutiny amongst local stakeholders.

The data provided by Marine Resources for this analysis consisted of catch volume (kg) and value (£ for Jersey, € for France) and effort (fishing days) by métier for 2015-19, averaged over the five years, by statistical rectangle and jurisdiction. In addition to this, spatial data on fishing effort (required to work out proportional effort in the Marine Park area) were provided on the distribution of catch within this area by km², as well as data on individual vessels (anonymised) which was used to characterise the mobile gear fleet.

In the case of Jersey, value was estimated from catch by multiplication by a price per kg. The price was estimated by the Marine Resources Section of the Jersey Government and was clear and transparent however the data were not designed for economic valuation. Whilst the data provides a valuable insight into the general levels of activity for Jersey and French vessels within a spatial context, figures are not absolute (i.e. the model is designed to look at relative landings and effort, not to produce economically precise data) and this is important to mention. There were also notable inconsistencies between French and Jersey value estimations (as discussed in other reports provided to BLUE) but as French values are not incorporated into the final cost benefit impact values, it is not discussed further here.

⁴ Greater availability of scallops to the hand diving sector, for example, due to their protection from dredging within the Marine Park.

2. Potential low impact fishery options for Jersey

Based on the latest UK Government led efforts to define low impact fishing, this section (summarised in Table 1 below) presents potential key constituents of a low impact fishing model. For each component, specific issues in Jersey fisheries have been identified, a variety of low impact solutions for each have been proposed, and the pros and cons of implementing such solutions on the island is also included. It is suggested that the information included in this section should be shared more widely with Jersey stakeholders for comment at a later stage before full feasibility of various options can be determined.

MEP were able to obtain information from a variety of stakeholders via virtual consultation to fill in parts of the table, including representatives from the States of Jersey Marine Resources team, the Jersey Fishermen's Association (JFA), Genuine Jersey, Co-op Channel Islands, the Jersey Alternative Fish Market, Pesky Fish, and Tautenay Ltd. Given the political sensitivities to this work, all stakeholders requested that specific pieces of information provided were not attributed to their respective organisations. For this reason, the information included in the remainder of the report is generally not referenced to specific stakeholders, but to 'stakeholders' in general.

The structure and main components of this section are based on a previous literature review⁵ of existing definitions of low impact fishing, followed by a co-design process with fisheries stakeholders. A summary of this research is provided in Williams et al., (2020). The literature review highlighted that reducing environmental impacts from fishing activities, in particular on stocks and the wider marine environment, were a common feature of existing definitions of low impact fishing. Reducing fish mortality was also important, and in other definitions, focus was on establishing legitimacy in relation to claims to fishing opportunity (e.g., in some definitions of small-scale, artisanal and inshore fishing) which emphasised the positive social and economic benefits of that particular type of fishing. This highlighted the importance of distinguishing between managing fishing mortality and managing fishing opportunity.

It is important to note that criteria for low impact fishing have by no means been finalised, and as far as is known, the results of this initial work are yet to be operationalised or taken forward by Defra into policy. In addition to this, what is considered low impact will be different for each region and thus it will be important for Jersey stakeholders to come up with their own set of low impact criteria, within the bounds of relevant UK fisheries policy.

For any one of the fisheries issues identified below (see Table 1 for simplified summary), it is likely that a combination of options proposed (rather than one option per issue identified) will be most effective in reducing impact. For example, for access rights, implementing a permit-based licensing scheme alongside a zonation system where specific areas are designated for closures and/or specific gears/metiers, may be notably more effective at achieving conservation objectives than one measure alone, but the collective costs/implications of both may not be significantly greater than a single approach.

The following sections expand on the information included in Table 1 and represent potential key components of low impact fishing in Jersey.

⁵ <http://www.ccri.ac.uk/lowimpactfishing/> see links at bottom of page

2.1 Seabed impact

Potential issues relating to seabed impact from fisheries in Jersey include: reductions in species richness, total abundance and assemblage composition resulting from the use of demersal mobile gears (scallop dredging and demersal wet fish trawling); similar impacts (but to a much lesser extent) from intense potting activity, and damage to sensitive marine habitats (e.g. seagrass meadows) from anchoring and mooring.

Negative ecosystem impacts from demersal fishing gears are well documented in the literature and the situation is likely to be similar in Jersey, certainly for intensely fished grounds and/or seasons, although specific data relating to pressures and impacts on marine flora and fauna in Jersey waters should be collected and/or assessed.

For potting activity, recent research by Gall et al., (2020) suggested that although current levels of potting within the South Devon Inshore Potting Agreement (IPA) were allowing benthic condition to be maintained and the relative health of the ecosystem to be greater than in adjacent areas where bottom towed fishing gear operates, concerns exist over impacts to long lived and slow growing taxa, which are particularly sensitive to potting. The haul was identified as the time during which most impacts may occur, and even though the area of damage is not the entire pot haul path, potting was found to be more destructive than previously thought. Also of note were the significant differences identified in impact between parlour and inkwell pots which may be of relevance to future decisions on sustainable management of potting activity, particularly in relation to the most sensitive habitats.

Regarding mooring damage, although specific data for Jersey could not be found, it is known that moorings can have a detrimental impact on seagrass by fragmenting meadows and causing habitat degradation. There is overlap between vessel mooring and anchoring and seagrass habitat in Jersey's inshore suggesting that damage may be occurring. Simple and inexpensive float modifications to traditional swing moorings have recently been shown to increase the seagrass density surrounding them (Luff et al., 2019).

All the above impacts can be reduced by either reducing or removing fishing activity in specific areas, or by implementing a combination of both across a wider area. The low impact solutions proposed for reducing seabed impact specifically include closing areas completely to certain fishing gears; switching to alternative fishing methods that are regulated within sustainable limits; switching to alternative fishing grounds; or reducing fishing effort in the same fishing areas. Benefits of such solutions include gains in natural capital and ecosystem services, gains over time in fisheries resources and reduced conflict in fishing grounds for other fishing gears that are still permitted.

The disadvantages of such solutions negatively impact fishers more than any other stakeholder group due to loss in income (at least over the short term), especially if mitigation (e.g. finding new grounds/using alternative gears) is not possible. In addition to this, there is likely to be disruption in supply of product to well established market routes (some fishing gears are more efficient at harvesting product than others) and increased costs for enforcement authorities to ensure compliance to new measures.

In Jersey, implementing such solutions will inevitably meet resistance and a full understanding of cost-benefit for each solution is required before implementation. This assessment should be based on a sound evidence base developed from reliable data. This in turn is more likely to lead to meaningful and enforceable legislation.

The impact of removing mobile gears from a proposed Marine Park area in Jersey has been analysed in more detail in this project (see Section 1) and provides an example of generating such an evidence base. Such a cost-benefit analysis that employs both a natural capital approach alongside a more traditional economic impact should be considered essential in the formulation of management strategies that aim to meet complex social, environmental and economic objectives. In doing so, the likely extent and quality of supporting, regulatory, provisioning and cultural ecosystem services can be taken into account and so the goods/benefits provided for society become an inherent feature of designated protected areas and changes in management.

Applying similar approaches for each low impact solution is suggested and if a combination of solutions are required, then the cumulative cost-benefit of all solutions would also need to be assessed. For example, in a future low impact model, if mobile gear is to be restricted from certain areas, static gear should also be subject to effort limits (not necessarily to do with seabed impacts) in order to ensure ecological and economic sustainability of the activity. Assessing true impact also requires some collection of primary data from stakeholders, which was not within the remit of this project. For example, the cost-benefit analysis (Section 1) made several assumptions, including that mobile gears currently fishing in the proposed Marine Park area are able to mitigate a certain proportion of their loss in income by moving grounds or switching gear. If time had been available, a more robust assessment would include individual mitigation capacity estimates from vessel owners, combined with historical data from similar situations where fishers have had to mitigate a loss in income.

If the state of the stocks and habitats can allow, implementing change gradually can also negate certain social and economic impacts and overall may facilitate enforcement and improve compliance over the long term. For example, instead of banning certain gears outright from an area, small changes to a fishing model such as phasing out gears in pilot areas, or reducing the numbers of dredges/pots used can still generate gains in ecosystem health. Carefully documenting these changes is therefore key to monitoring the success of certain measures and to adapting quickly if required to obtain more benefit (or minimise costs).

It is also important to highlight the situation in Jersey is unique when compared to other similar fisheries in the UK due to French access to the Jersey zone under the TCA. The French mobile gear sector is much more significant in terms of fleet size and overall impact than the Jersey mobile fleet so managerial changes must be applied fairly based on perceived impact (see 'Conclusions' below for further details).

The benefits of implementing change must outweigh the risks when all aspects are considered. Regulators should decide what level of impact is 'acceptable' - with this decision making typically taking into consideration avoidance of compromise of the ability of an area to meet defined conservation objectives and targets. Alongside consideration of ecological impact, they must consider the value of the fishing activity occurring within a protected area and determine the social and economic impacts of management decisions.

2.2 Target stock population

Potential issues relating to target stock population in Jersey include indications of decline in brown crab, lobster, whelk, bass and scallop stocks (based on information provided in latest 2019 Jersey Marine Resources Annual Report⁶).

There are several low impact solutions that can be implemented to reverse stock decline and have been included under the general themes of access rights, quota management, technical measures, improving science and data, and supply chain (summarised in Table 1).

2.2.1 Access rights

Low impact solutions relating to management of access rights might include one or more of the following: reducing/removing fishing intensity (also discussed in Section 2.1 above); implementing a metier/species-based permit system, introducing zonation (seasonal/permanent) for different activities; and implementing ecosystem-based (rather than species-based) management.

At the time of writing, the system controlling access rights to Jersey waters was undergoing change post-Brexit. Licencing negotiations between the UK and the EU, allowing French vessels access to Jersey waters, have inevitably been contentious and although temporary and permanent licences have been granted for the year⁷, more detailed negotiations over specific licensing conditions are believed to be ongoing.

When such negotiations have settled, there is an opportunity for Jersey to change the way fishing rights are granted to better suit the island's unique environment and fishing sector. Common points raised by several stakeholders during MEP's initial consultations were that any future management system within TCA terms should be applied equally to permitted French and Jersey fleets and should ensure the fishery is sustainable and works in harmony with the marine environment and other areas of marine management.

Several of the six principles of the Jersey Fishermen's Association (JFA) manifesto⁸, specifically refer to access rights, including establishing a fair permit system. Any future system should consider these concerns and those of the EU when being developed.

Such a system might implement metier/species-based permits where total numbers granted are capped based on conditions reflecting evidence of stock health. Other management measures can also be incorporated into permits, including metier/species technical measures and/or quotas relating to catch/metier. The benefits of such systems allow ecosystem-based management to be better incorporated which not only provides better overall ecological resilience in the long term but creates more opportunities for traceability and meaningful ecolabelling schemes. Permit-based systems are already implemented in the French fleet that fish in Jersey waters, and it is reported that the Jersey fleet also effectively operate on permits for most species, so formal change to such a system should be relatively simple to implement.

Williams et al., (2020) reported a consensus (amongst UK fishers consulted) that the current licensing system in the UK needs to be reviewed as it creates conflict and causes environmental damage. Fishers reported that: they were knowingly fishing beyond thresholds

⁶ <https://www.gov.je/Government/Pages/StatesReports.aspx?ReportID=5292>

⁷ <https://www.bbc.co.uk/news/world-europe-jersey-58732292>

⁸ <https://www.fishersmanifesto.je/learn-more>

to maintain fishing entitlements; they were fishing in other fisheries and increasing fishing effort to maintain the value of their licence; conflict arises due to full-time and part-time fishers being given equal opportunities; and allowing nomadic fishing (particularly dredgers and large trawlers) to take place in local areas was causing conflict and negative environmental impact on local fish stocks and marine habitats. It is unknown whether these issues are specifically occurring in Jersey waters, but it is important to reference them here as a consideration for future access rights. Fishers should be able to maintain a portfolio of options without increasing creating environmental damage.

Implementing a spatial element to access rights, such as zonation, can be an important tool in reducing stock decline. Zonation is a broad term and can encompass seasonal/permanent closures and be implemented for a variety of objectives. Carefully planned zonation is in line with ecosystem-based management principles and can bring a multitude of benefits including: reducing conflict between métiers; protection of sensitive habitats or spawning/nursery grounds; preventing the over expansion of certain fisheries; adding value to key catches; increasing natural capital; and creating the marine equivalent of wildlife corridors. As raised by stakeholders in the Williams et al., (2020) report, a principle of the 'right gear in the right area' is needed, with management being tailored to the local area and fleets. For example, fishers consulted in this research reported that closed areas for spawning seasons were considered hard to achieve because, for example, some slower fishing vessels did not have the range to travel outside the required area closures during certain spawning seasons.

Co-management supports a flexible management system and may encourage fishers to experiment with gears that are less deleterious. However, this is only if fishers are actively included in the planning phase for changes to regulations/policy in order to share responsibility and accountability and make use of fisher knowledge. A shift to real co-management is required and a first step might include the formalisation of a multistakeholder working group on Jersey, which can in turn develop an Integrated Fisheries Management Plan for future zonation. Co-management mechanisms incorporated might include voluntary codes of conduct, fishers as peer police (both shown to be very successful in other parts of the UK as fisher led) and mutual development of technical measures (see 2.2.3 below). IFCA co-management approaches were suggested as a good example of fleet-based co-management approaches.

The South Devon Inshore Potting Agreement (IPA) in England is an example of successfully implemented zonation, whereby static and mobile fishing gears are separated from large areas of the seabed, allowing fishers from both sectors to operate profitably on traditional fishing grounds. Beneficial side effects have included improvements in marine biodiversity in the areas where towed gears have been excluded, significant increases in the biomass of hydroids, soft corals and other important nursery habitats, increased scallop densities within the areas closed to towed gears, increased scallop recruitment both inside and outside the protected areas, and increases in a number of fish species. Other case studies with similar results from spatial zonation, integrated fisheries management and voluntary codes of conduct include the Port Erin Closed Area in the Isle of Man and the Lyme Bay Marine Protected Area (MPA) in Dorset and Devon, England.

Finally, as reported by Williams et al., (2020), marine licencing was raised as a major issue by UK fisher stakeholders, whereby banning of certain types of fishing activity in certain areas did not make sense if aggregate extraction was permitted. Other activities in the marine

environment, including recreational activities, should therefore also be reviewed for their ecological, economic and social impact when fishery zonation is planned.

2.2.2 Quota

Low impact solutions relating to management of access rights might also include changes to quota management (such as implementing annual/quarterly quotas instead of monthly) or allowing more flexibility in the quota system (such as rolling over of unused quota).

Advantages of such changes include enabling fishing in preferable seasons and weather, which subsequently improves fisher safety, results in less quota wastage, and potentially generates a more seasonal fish market. For Jersey, increasing the supply of seasonal fish on the island has many benefits as discussed below under 'Supply chain', including less reliance on imports.

Changes to the quota system must currently be enacted at the central government level, which prevents implementation over the short term. The fishery for quota species on Jersey (including sole, plaice, mackerel, pollock, skate and ray) is however very limited and many of the issues described are not currently significant considerations for Jersey's fleet. The current structure of Jersey's fleet may however be a result of the historic approach to quota management in the UK. As reported by Williams et al., (2020), quota management in the UK was perceived by all consulted stakeholders to have created inequity within the fleet and negative environmental impacts, such as effort shifts and subsequent overfishing on non-quota species (crab and lobster). Further, current quota management was raised as a major barrier for lowering the impact of fishing, and a barrier to running fishing businesses effectively for the under 10 metres sector. An improved method for distributing quota in the under 10m sector is required and may be pertinent to Jersey in the future.

2.2.3 Technical measures

Technical measures (such as mesh sizes and minimum landing sizes) to reduce impact on target stocks are already incorporated in Jersey but sufficient enforcement of these measures and sufficient monitoring of their effectiveness on the stock is also required. Other technical measures, such as static pot limits and trawl regulations are likely to require updating/implementing in Jersey given the indications of stock decline. Using co-management approaches, fishers can help develop appropriate recommendations on technical measures, which in turn improves trust between stakeholders and compliance.

2.2.4 Improving science and data

Undertaking appropriate sampling and monitoring of landed catch and at sea surveys, improving the speed at which data on fish stocks is incorporated into management decisions, creating fisher-science partnerships to better understand population distribution, mortality and seabed/ecosystem impacts (for example), and publishing annual fisheries reports at métier level to provide regular information on fishing effort, are all suggested solutions to improving the scientific evidence base for Jersey fisheries. Scientific monitoring is carried out by the Jersey Government and regular assessments are undertaken for some species, but more resources are required to provide a sufficient level of information on all key stocks and especially those in notable decline.

The foundation for fisher-science partnerships already exists in Jersey, as scientific working groups were established under the previous Granville Bay Agreement (GBA) for purposes of

data sharing, joint assessment and consultation. Re-vamping such groups and implementing co-management approaches as described above may help improve relations between the EU and the UK in the future. A Marine Economy Advisory Group and a Fisheries and Marine Resources Panel also exist on Jersey and efforts should be harmonised.

2.2.5 Supply chain

Making changes to elements of the fisheries supply chain can have an important influence on stock health. An important part of a successful low impact model is obtaining a higher market value for fish caught in a 'low impact' manner because the current lack of market premium for low impact seafood was viewed by fishers as a considerable disincentive to adopt relevant fisheries practices (Williams et al., 2020). Various ways of achieving a higher market value for low impact products were proposed during our consultations and are summarised in this section.

In general, stakeholders identified the need for Jersey's fishing industry (fleet, buyers, retailers) to work in a more cooperative manner in order to diversify away from the current high dependence on continental exports. It was further highlighted that unless the fisheries sector is able to move to a situation where it can bring the bulk of catch, from the numerous small and medium size boats and metiers, to a centralised location, and provide the critical mass of product at correct standards needed to overcome the main barriers to exporting elsewhere, Jersey are unlikely to be able to develop new markets, either on or off island.

Although no trade statistics were available to analyse in this study, several stakeholders informed MEP that the majority of seafood consumed on Jersey is imported (notably though little product was said to be imported from France) and the majority of local Jersey catch is exported. Fish consumption of Jersey residents was reportedly 'low' (again, no statistics available) and was restricted by the high price of fish. For Jersey buyers, most wet fish is sold directly via roadside vans, at the fish market, or off the quay. Crustaceans are mainly exported to Europe on bulk, and there is no central fish auction. Apart from a few individual fisher merchants and whole-sale merchants like Aqua-Mar, overall, it seems more value addition could be achieved. Jersey is an affluent island, which should provide more opportunity for value addition in the local seafood market than in other locations, although full advantage of this may not be being taken.

Considering a lack of trade statistics, when speaking with stakeholders, we attempted to identify gaps or saturations in the market. It was important to identify, where possible, when supply did not meet demand, or vice versa. For example, could seasonal shortages of scallops in France be met by Jersey fisheries? Are the recent increases in numbers of spider crabs on the island being taken advantage of?

A common recommendation was for Jersey to first develop a fisheries marketing strategy (e.g. spanning a 5 year period), based on detailed market research and trade data on local and off-island consumer preferences and to identify barriers and potential opportunities for the development of certain fishery products and supporting supply chains. This could include specific research into Jersey supplying low impact fisheries products. From our initial consultations in this study, and similar to the results of the Rural Economy Research Results (to inform the 2022-2027 Rural Economy Strategy), buying local fish was more important to Jersey consumers than buying sustainable fish, so future marketing of products will require careful thought to ensure targeting of local markets. A fisheries marketing strategy was noted

by stakeholders to be part of the ongoing scoping for a fishers' co-operative and island seafood processing hub so it is important that efforts are not duplicated.

Our consultations revealed several potential methods of obtaining a higher market value for 'low impact' fisheries products in the supply chain. Given some of the aforementioned barriers to market diversification, implementing a combination of the below methods are likely to be more successful.

1. **Improve public awareness of low impact fishing**

Currently low impact fishing is not well defined which provides an immediate barrier, but if Jersey can develop and adopt its own definition, then regular public awareness events or campaigns can educate the public on fisheries products from healthy stocks, those that are available in-season, the diversity of products available and where they can be purchased. Examples might include 'Jersey fisheries week', or seafood sales as part of a 'buy local month'. Jersey used to have a seafood festival, but it was said to have been stopped due to lack of funding, motivation, and health and safety issues. In future it may be pertinent to consider re-establishing this as islanders have expressed interest on local fora (the Jersey Alternative Fish Market). Similar activities are run at the annual boat show and feasibility of a seafood festival could therefore be re-assessed.

2. **Eco-labelling**

Stakeholders raised that greater impact may be achieved by Jersey seafood products being marketed under one standard, such as the Genuine Jersey label which is well known on the island and regionally. On the other hand, there has been a low uptake of MSC labelled products on the island. As mentioned above, sustainability accredited schemes such as the MSC, seem less popular on Jersey (when compared to local), so considering these aspects, a potential opportunity may exist in the development of a low impact label (linked to certain fisheries management aspects/conditions) under Genuine Jersey. Promoting new products on Jersey may be easier than most places due to its size, so a good opportunity exists for marketing different products.

3. **Diversify the products available on the market** to sell more of what is in season/what is currently sustainable/what is local. Potential options suggested by stakeholders included:

a) *Improve links between fish merchants, buyers and fishers –*

Buyers then have more ability to demand 'low impact' products (in-season, traceable, sustainable etc). Furthermore, a role for buyers/merchants could be seen not only in marketing low impact fisheries, but also as a means of enforcement through traceability of products. Improved relations between merchants and fishers has been suggested as a way to overcome this barrier (Williams et al., 2020).

b) *Set up a Jersey Fishers Co-operative –*

Such an outfit could command and control a better price for fishers (prices on Jersey generally only fluctuate marginally), and for the buyer (particularly restaurants), and sourcing from a fishers co-operative gives more security and a better selection of seasonal products. Currently buyers (and fishers selling certain products) are limited to a few options (individual fish stalls or wholesalers such as AquaMar), and high prices restrict greater consumption of seafood. MEP were informed by BLUE that a scoping project was underway for a fishers' hub and cooperative, but the results were not available at the time of writing.

c) *Set up an island restaurant scheme to sell more 'low impact' fish and operate more seasonally –*

This could see fishers and chefs developing novel dishes to diversify menus in Jersey restaurants and offer 'catch of the day/month' more regularly. The potential method of offering local, seasonal menus might include establishing a chain of eateries all using the same remit/suppliers of fresh, local, and seasonal ingredients with very similar menus. Jersey has a growing reputation for its food hospitality and there are many restaurants on the island (including many considered 'high-end'), which provides an opportunity for fishers to generate good returns. Stakeholders reported that many chefs via local groups (Jersey Alternative Fish Market, Jersey Foragers) have expressed an interest in using more local produce under such a scheme. Barriers to overcome include some reported difficulty with knowledge of preparing such dishes and/or what was available in season (seasonal chef labour), a manager's influence on diversification of the menu, and consumer demand. To implement such a scheme may also then require a managerial/chef training programme. In addition to this, if producers/buyers had the ability to freeze seasonal fish when it is landed (see d below), then pressure is reduced on seasonal sales and reliance is reduced on fish imports, such as current practice of importing of farmed bream/bass from Europe to supply white fish demand to the island. To incentivise such a scheme, it was suggested that a new culinary award could be given to establishments that use a certain proportion of 'low impact' ingredients (for example, Bronze for 50-75%, Silver for >75%-99%, and the coveted Gold for 100%). An organisation such as Jersey Hospitality could take the lead on designing such a scheme, perhaps eventually led by a future Fishers' Co-operative (see b above) to manage as another revenue string.

d) *Set up a central processing centre on the island to diversify seafood products available for export –*

Jersey lacks a large-scale commercial fish processing plant and such a centre could provide a minimum array of services such as crab-picking, vac-packing and freezing. It would require a commercial clean kitchen including vac-pack machine, blast freezer and cold storage area, away from bait storage areas. An example of a processing line provided at the centre could include (using wet fish as an example): scaling, filleting, pin boning, washing, addition of butter/herbs, vac-packing, freezing, and labelling. For crab, depending on demand/supply/stock health, brown or spider crab could be picked and packaged for sale/export. Year-round labour would be required according to supply and demand fluctuations so any such initiative should be informed by a full economic feasibility study (or be part of fisheries marketing strategy research). In early 2021, a scoping study for a seafood processing 'hub' was underway so it will be important to review the results of this study when complete. Discussions about whether the Government could help fund the creation of a processing centre were ongoing in early 2021 yet it was recently reported by the Jersey Bailiwick Express⁹ that this was unlikely due to local complexities (e.g. competition with other secondary fish processors and expiry of the Fiscal Stimulus Fund) and the creation of such a facility would likely have to be driven by the private sector.

e) *Developing the Jersey Alternative Fish Market (JAFM) –*

⁹ https://www.bailiwickexpress.com/jsv/news/gov-steps-fund-fishers-tangled-french-row/?fbclid=IwAR2kInSimdBhtw8feY9hG3_epuvTlzDFB6cT66yWpxRZw7Q0Xm1Sw-gFx6Y#.YZuOldDP02y

As stated on their Facebook page, “*this is a Jersey Facebook group to help save our fishing fleet by diverting the now defunct export, and local bulk order market, direct to local buyers*”. The group, reportedly representing around 10% of the island’s population, provides regular updates on local seasonal catches, sales and events, and also raises current fisheries and supply chain issues for public discussion. Given its local success over the pandemic in promoting the consumption of local seafood, the JAFM may only require minimal technical and financial support for further development. For example, support may be required to develop a more formal online marketplace by setting up a separate selling subpage. The online marketplace could then deliver Jersey fish to a buyers co-operative at wholesale prices (given prices are one of the main limiting factors for weekly fish consumption).

The supporting infrastructure required may require a chiller truck and HACCP and food hygiene qualifications for staff. This is similar to the service provided by Pesky Fish but on a smaller scale¹⁰. Until a processing centre on the island is established, or a processing unit is available to such an operation, the market will be limited to live crustaceans and whole, ungutted, fresh fish. Finally, it is important to note that this service would be in direct competition with a future Fishers’ Co-operative so collaboration should be considered.

f) *Explore opportunities in the export market –*

Currently, the export market from Jersey is mainly made up of surplus product that cannot be sold locally (partly due to limited local demand). Once local Jersey vessels have landed catch, companies such as Aqua-Mar buy some product from these vessels and then enhance export orders with product from Guernsey and French vessels to meet demand from Europe. It is assumed that only Aqua-Mar currently provides this export service from Jersey. Scope for developing an alternative (competitive) service may be limited but perhaps worth investigating so that buyers and fishers have more options. To provide a bulk export supply to France or elsewhere, landings of shellfish, oysters and wet fish would need to be concentrated within a single market/location on Jersey, and may also combine with some of Guernsey’s landings. Weight reduction (shells, bones etc) is key to obtaining the best £/kg prices for distribution. These actions are most pertinent for export routes further afield than France, such as to mainland UK via Condor ferries or DHL. Currently minimal product from Jersey is exported to mainland UK as mainland UK buyers can source similar products from closer UK mainland fisheries, such as scallops from Dorset or lobsters from Brixham. If landings are consolidated and made cost effective, Condor Ferries/DHL could retain liability for the product as it is transported, so that fishers/suppliers get the sale agreed and payment for the catch before it leaves port. Most opportunity exists for products that sell for a higher price on UK mainland than on Jersey, allowing products to be marked up accordingly. Bass may be an example of this.

The current barriers to exporting more fish from Jersey will not always exist. Geographically, France will always be the most logical option in terms of logistics so export opportunities here in particular should be re-visited. For example, from May to September there appears to be a lag in French scallop catch, which Jersey could perhaps partly fill. As seen in Lyme Bay, Dorset, shellfish toxin testing kits could be provided to scallop fishers in order for them to register with Environmental Health and comply with current EU regulations.

¹⁰ <https://peskyfish.co.uk/>

g) *Renaming fish* –

Although a major impact is not expected, stakeholders identified potential value addition benefits in renaming mullet, skate, ray, eel and gurnard. There is perhaps some benefit in renaming spider crab to ‘Jersey crab’ but all would need to be informed by a dedicated fisheries marketing strategy as mentioned above.

4. Government economic support to incentivise local product buying –

Several options for Government economic support were raised by stakeholders, including implementing a cap on imported seafood produce on the island. Local seafood could then be protected in the same way that Jersey Dairy is protected. Such an option would have to be thoroughly reviewed for its feasibility due to the potential issues with local supply and demand and may only be successful when other actions (as mentioned above) are successfully implemented (such as available freezing facilities for seasonal fish, restaurant scheme and public events to raise demand for local fish, etc). Increasing demand for specific local products would also need to be carefully managed as the most efficient methods of catching certain species may not be considered ‘low impact’. For example, if demersal trawling is the most efficient method of catching a species, an increase in this fishing activity may occur. On the other hand, if such fishing methods are banned or restricted in areas of Jersey’s waters, alternative fishing methods would need to be able to meet supply. Local prices may also increase and restrict sales. A thorough review of Jersey fish trade statistics would need to take place (or collection of primary data) to identify opportunities.

Other economic support avenues for the Government that were mentioned by stakeholders included: subsidising transport costs for export (related to f above); implementing a subsidised price for ‘low impact’ seafood products on the island; providing financial support or free training for fishers to diversify businesses in order to sell and market low impact products; and support for setting up a Jersey Fishers’ Co-operative.

5. Low impact produce section in all supermarkets/large shops –

This is only feasible if there is enough supply (from consultations, it was indicated that demand is not an issue). Retailers will also need to be willing to give away some initial margin to support volume-based markets. During consultations with the local Co-Operative (Co-Op) supermarket, it was indicated that they would welcome more local product such as picked crab. Small outfits on Jersey such as ‘Crabs Direct’ fish and process picked crab singly and as part of seafood platters. They currently have a good reputation, a 4-star food rating and HACCP policy so could be potential suppliers to Co-op Channel Islands. In future, such platters could display a low impact seafood label. At Co-op St Peter, there is also already an existing seafood concession, and a similar business model could be replicated if deemed feasible. Other supermarkets (such as Waitrose) appear to have more barriers for selling this type of produce as they tend to have a very small group of unchanging suppliers, require more consistency in supply. However, as with many options discussed in this section, a detailed feasibility study would be required to identify all barriers and opportunities for each potential retailer.

2.3 Bycatch and discards

Although identified as a key element of low impact fishing, bycatch and associated discards are not a major issue in the Jersey fleet, as only one trawler is operational. The French fleet

do however have a more substantial pair trawling fleet, although the current licensed number in Jersey waters is unknown. An analysis of bycatch and discarding in the French trawl fleets should be considered if access is to continue under the TCA and a low impact model is implemented in the future.

Common bycatch issues (mostly associated with otter trawling) in UK fisheries include poor selectivity, capture of seabirds and cetaceans, and ecosystem impacts of discarding catches on land rather than at sea. Some low impact solutions identified by Williams et al. (2020) include: allowing very small vessels (5-6m length) to land bycatch, use of more selective gears, and finding other uses for discards (which do not contribute to increased market demand of bycatch species considered to have poor stock health).

Notably the Jersey Marine Resources team do carry out various activities to monitor and reduce bycatch in the fleet. For the 2021 scallop assessment, bycatch data were collected from scallop dredging operations (clams, crabs, starfish, etc) and some were noted to survive when returned to the sea. The team also conducted a thorough study of netting for fish across different mesh sizes, measuring fish size and recovery time (in live wells), on commissioned fishing trips. The study revealed there are optimal mesh sizes that can reduce bycatch to almost nothing and eventually the results will be used to create a limited (permitted) netting fishery.

2.4 Plastic and pollution

Plastic pollution in general was not identified as an issue in the Jersey fleet, however, an issue with ghost gear dumping was reported to MEP during consultations. The local waste processing plant on the island will only accept a very small number of pots at a time and only rope that is cut into 1 metre lengths. Consequently, gear is discarded at sea, as this represents the easier option. Proposed solutions might include increasing the capacity of the local processing plant and incentivising its use (e.g. reward scheme for vessels that use the facility). Monofilament gillnets are also used in Jersey's fleet, which, once lost at sea do not degrade and contribute further to ghost fishing, so recycling such nets in appropriate onshore facilities could help mitigate this impact. Williams et al., (2020) reported that fishers in general considered recycling options offered by ports to be limited due to the different materials used in gear construction, the labour involved in deconstruction and the lack of downstream interest in the materials such as recycled ropes. A national scheme linking materials recyclers with transporters was suggested within the UK report, but this would not be logistically viable for Jersey. Sufficient services on island would therefore be required.

Commonly identified plastic pollution issues in UK fisheries include the use of single use plastics in the fleet, the use of plastics in trawl materials, and conflict between fishers setting gear in the same areas – resulting in lost gear. These were not deemed to be issues specific to Jersey based on stakeholder discussions but to avoid such problems in the future, solutions such as zonation, gear flagging (and associated fora to raise awareness of such activities) and consideration of non-plastic materials in fishing gears, could be implemented. Williams et al., (2020) reported that fishers suggested that if all pots and nets were tagged and recorded at the beginning of the year, then checked off at year end in a port-level census, then penalties could be applied to those that had lost gear (with the exception of some circumstances such as gear conflict).

Other pollution issues (not plastic related) commonly identified for UK fisheries were spillage of oil and fuel and the dumping of bilge water into the marine environment. In Jersey, it is likely that there is some pollution from fishing vessels but monitoring of this does not appear to be regular and specific figures/reports could not be found. No specific spillage incidents could be identified. If in future, increased monitoring of pollution from fishing vessels reveals negative impacts on the marine environment, low impact solutions could include: provision of facilities for disposal of used oil; bans on pumping out bilge water; and improved fishing vessel design to reduce pollutant leakage. Increased monitoring is an important first step.

2.5 Carbon emissions

The seafood industry has a substantial carbon footprint¹¹ e.g., through disturbance of blue carbon (carbon captured and stored in marine habitats and species, which can exceed terrestrial ecosystems such as forests and peatlands), fuel use and greenhouse gas emissions by fishing vessels, refrigeration and transport of produce. Fishing vessels are known emitters of greenhouse gases. As reported in a recent study, globally, the practice of bottom trawling was responsible for one gigaton of carbon emissions annually (on average) which is equivalent to all emissions from aviation worldwide (Sala et al., 2021). Although bottom trawling is not a key feature of Jersey fisheries, it is still worth considering the carbon emissions of the Jersey fleet, and the French fleets licensed to fish in Jersey waters when estimating impact.

However, a holistic approach to the assessment and consideration of the carbon footprint of the Jersey's seafood production is required. Such an approach would need to consider, for example, emissions per kg of production (as these vary greatly depending on where and how fishing practices take place and the target species, for example – and can in fact be relatively high for pot and trap fisheries¹²), as well as emissions associated with the processing and transportation phases, and the impacts of fishing on blue carbon habitats and stocks.

Fishing on depleted fish stocks requires more fuel per kilo of landed fish than fishing on abundant fish stocks, because low fish abundance forces fishers to search longer and use heavier gear to catch the fish. If fish stocks are able to recover, less fuel would be needed to catch the same amount of fish. In addition, enhancing fish abundance allows fish populations to become more resilient to the impacts of climate change (STECF, 2007).

To reduce carbon emissions, improving fuel efficiency and switching to lower-carbon technologies for vessel engines are two low impact options commonly suggested. As noted by Williams et al., (2020), the fishing industry thought that addressing fuel use was an area where most improvement could be relatively easily achieved, and often aligns with the principles of running an efficient fishing business. Improving engine efficiency could be achieved by subsidising engine upgrading (either to diesel electric hybrids or hydrogen cells), which would reduce carbon emissions. However, a shift to less fuel-intensive and low-impact fishing methods and gears provides a more sustainable long-term solution than simply using more energy efficient engines. More efficient engines would initially reduce fuel consumption but in the longer term can worsen the situation by contributing to an increase in fishing effort,

¹¹ <https://www.wwf.org.uk/achieving-climate-smart-fisheries>

¹² <http://seafoodco2.dal.ca/>

leading to further depletion of fish stocks. This would result in fishers having to go further to find fish and in doing so use more fuel per kilo of landed fish, leading to further stock depletion, increasing CO₂ emissions and habitat impacts (STECF, 2007).

A change in fishing methods and gears can be promoted by removing environmentally harmful fuel subsidies and phasing out fuel tax exemption for fisheries, while at the same time providing financial and other incentives for alternative fishing techniques. If any of these are pertinent to Jersey, it is suggested these are reviewed.

A first step for Jersey could be to obtain an age profile of operational fleets (both Jersey and French) which is currently not known, estimate fuel efficiency, and identify potential areas of improvement in terms of carbon emissions. When doing so, it will also be important to consider carbon more holistically, such as the impact on removal of blue carbon by these fleets through catching species and impacting habitats. The Jersey Marine Resources team has recently updated a research report on blue carbon in Jersey so the results should be considered when available. Ultimately, a Life Cycle Assessment (LCA) approach would serve to establish the carbon footprint baseline for the different fleet metiers in order that achievable targets could be established and progress towards them monitored over agreed timescales.

2.6 Fish welfare

Fish welfare was identified by Williams et al., (2020) as a key element of low impact fishing, the main issue being that there is a common belief in fishing that poor treatment of fish is unavoidable. This is also likely the case in Jersey as minimal information could be found relating to Jersey fisheries and it was not raised as an issue by Jersey stakeholders. There are island-wide animal welfare laws but it was not clear whether these applied to commercial fish and shellfish. There are however specific regulations and licence conditions that include no live winging of rays.

Lack of stakeholder awareness of fish welfare issues may be due to a lack of education (which is a UK-wide issue). Fish welfare issues are however discussed by the group FishCount¹³ and include:

- Pursued to exhaustion by nets
- Crushed under the weight of other fish in trawl nets
- Raised from deep water and suffer decompression effects e.g. Burst swim bladders
- Snared in gill nets
- Spiked with hooks to bring them aboard (if gaffing is used)
- Impaled live on hooks as bait (if live bait is used)
- Processed, e.g. Gutted, while alive and conscious.

The above should be discussed in future with stakeholders if a low impact model is to be implemented. Methods of improving fish welfare could start with improved education, such as introducing improved handling techniques to reduce unintended post-release mortality.

Finally, as discussed by FishCount, there may be future opportunities to add value to 'high welfare' fish products, similar to the current market for land-based 'high-welfare' products.

¹³ <http://fishcount.org.uk/uk-strategy#5value>

2.7 Other impacts

The impacts below were identified by the Williams et al., (2020) study as other important elements to consider for low impact fishing, so have been considered for Jersey for consistency with the latest research.

2.7.1 Bait digging

Bait digging (the main impact being habitat damage) is not a commercial activity in Jersey although it has caused issues in Guernsey in the past. Jersey passed laws setting recreational bag limits for a large number of species including those targeted for bait (worms, razor fish, limpets, etc.) specifically to prevent a commercial fishery developing by accident.

2.7.2 Impacts on endangered species

The capture of and impact on endangered, threatened or protected (ETP) species from fishing activities varies greatly depending on the fishery, area and species of concern. The capture of ETP species was not considered a major issue in Jersey's waters, mainly due to the nature of the fisheries (primarily static) and habitats present, although there is some uncertainty as a result of limited data and monitoring. There is a pair trawling team that operates regularly but the Marine Resources team reported they were not aware of the catch composition relating to ETP species. The team also noted that around ten dolphins wash up dead annually, some of which have been caught in fishing gear (e.g. a rope tied round the tail, damaged beaks, signs of drowning) but origin of the catch is unknown. The team have also requested dolphin bycatch figures from France in the past, but no information was provided.

The Marine Resources team have just expanded the protected species list (Conservation of Wildlife Law) to include many more marine species including all pelagic sharks, sturgeon and sun fish, whereas in the past just mammals and reptiles were included.

2.7.3 Social impact

Social impact (e.g. impact to fisher livelihoods) is an important consideration in any proposed change to a fisheries management system and should be a key part of any supporting evidence base. Implementing a low impact fishery model should also consider minimal impact to fisher livelihoods without undermining conservation objectives. Analysing the economic impact of closing areas to fishing is one example. Collecting accurate and representative data on fisheries livelihoods and economic impact is often hindered by the fact that it is only required sporadically (for specific projects or managerial changes) and therefore needs to be collected and analysed relatively quickly. This restricts the type of data that can be obtained (secondary, rather than primary livelihood data) and may disguise the true impact of proposed changes on fisher livelihoods. A solution may be for Jersey to implement more regular monitoring of fisher income, profit and economic viability, providing a longer-term database from which to access information when required. This creates a transparent system and benefits both managers and fishers when sound evidence is required to support decisions or campaigns.

Another pertinent social issue in fisheries in Jersey is the low entry of young professionals into the industry, which is also a UK-wide issue. The cost of a UK licence (which is required before a Jersey licence can be issued) can be significant and is a barrier to new entrants. Young fisher / new entrant incentive schemes can be a potential solution to this problem, although notably in 2017 this was attempted in Jersey with limited success, attributed to a lack of experience causing overall loss in revenue, and the scheme not having support from existing fishers. There is no reason why such a scheme could not be attempted again in Jersey, but

consultations with the fishery would be required to determine appetite and the most effective way to implement it.

Another consideration is whether encouraging increased fishing effort on stocks already under pressure is an approach the Government of Jersey wishes to advocate. The Jersey fishery may already be too large (127 vessels) and is currently still too focused on declining stocks such as crab, lobster and whelk.

Table 1: Proposed low impact fisheries options in Jersey

Low impact component	Relevant issues in Jersey	Low impact solutions	Implementation in Jersey		Other comments/info
			Potential pros	Potential cons	
Seabed impact	Scallop dredging - negative impacts on species richness and abundance of such demersal mobile gears well documented	1. Close more areas to scallop dredging (e.g. Marine Park)	Small number of vessels in fleet (some of which are already polyvalent)	Affected fishers (especially those that are not already polyvalent) must spend time mitigating to avoid loss in income (new grounds/new gears)	
			Habitat protection and potentially significant increase in natural capital (see cost benefit assessment, Task 2)	Removing such a small number of vessels could be seen as unnecessarily disruptive	
			Overall estimated loss in (first sale) income offset by estimated gain in scallop resources (see cost benefit assessment, Task 2)	Increased enforcement costs	Economic impact on downstream businesses not analysed in study so unknown but potentially significant given 10x increase in added value of scallops
		2. Switch to alternative fishing methods that are regulated within sustainable limits	Pros as above	Scallop diving capacity on the island may not be able to match the supply provided by scallop dredging so market impacts	
				If fishers do not wish to mitigate, traditional skills are lost in the community	
				Effort concentrated in very localised areas	If management measures are not introduced in parallel to mitigate this risk
		3. Switch to alternative fishing grounds for scallop	Alternative fishing grounds are available, especially if there is reduced access for EU vessels in the same grounds as a result of the implementation of the TCA (therefore potential for reduced competition between local and foreign vessels).	Alternative grounds are further from home port so reduced profit – and may just result in displacement of impact	<p>To date (March 2022), licences have been offered to 130 vessels which applied to fish in Jersey’s waters. A Temporary licence has been granted for 1 vessel which needs to provide further evidence of previous fishing. Unknown how many EU scallop dredgers now have access to the Jersey zone.</p> <p>https://www.gov.uk/guidance/united-kingdom-single-issuing-authority-ukia#crown-dependencies</p> <p>It should also be noted that it is not yet clear whether the number of licences issued to French vessels represents a reduction on the previous levels of French effort in Jersey’s waters (under the Bay of Granville Agreement).</p> <p>TCA details for Jersey in Article 502:</p> <p>https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/982648/TS_8.2021_UK_EU_EAEC_Trade_and_Cooperation_Agreement.pdf</p>

			Increased competition in new grounds	
	4. Reduce intensity / impact of current inshore scallop dredge fishery E.g: change in rotation of grounds /limit days at sea / new catch limits / limit no. of tows / target less sensitive habitats (e.g. areas which are sandy or experience more dynamic wave action) / separation of static and mobile fishing gears from large areas of the seabed by zonation	Maintains efficient method of collecting scallops so existing supply chains maintained	Natural capital gains less than for closed areas	
		In general allows for less localised fishing compared with diving as fishing effort is distributed over larger area	Increased enforcement costs	
		Less economic impact than closures		
<i>Bottom trawling - negative impacts on species richness and abundance of such demersal mobile gears well documented</i>	1. Close more areas to bottom trawling (e.g. Marine Park)	Pros similar to above but only 1 vessel in fleet so less managerial change, suitable alternative grounds, and gain in natural capital.	Cons as above but fewer vessels in fleet so less overall economic impact	
	2. Switch to alternative fishing methods that are regulated within sustainable limits (e.g. netting for sole, turbot, rays, bream, cuttlefish)	Pros as above	Cons as above	
		Net fishery for target species relatively low level in Jersey waters so less competition and opportunity for development	Potentially weak existing market for target species so will require investment	
	3. Switch to alternative fishing grounds	Alternative fishing grounds available, especially if reduced access for EU vessels in the same grounds		
	4. Reduce intensity of current bottom trawl fishery (examples as above)	Pros as above for scallop but only considers 1 vessel	Cons above for scallop but only considers 1 vessel	
<i>Potting - intense potting activity now considered more destructive than previously thought</i> https://www.sciencedirect.com/science/article/abs/pii/S0141113619308657?via%3Dihub	1. Reduce intensity of existing pot/trap fishery (define sustainable potting limits/zonation/seasonal ground rotation/pot limit per fisher or per area)	Potential gains in habitat protection and increase in natural capital over the long term due to significant proportion of Jersey's fleet being potters	Largest proportion of Jersey's fishing fleet so would require significant consultation	
			Increased enforcement costs	
			Very few long-term studies (> 1 year) that consider the effects of commercial pot fishing on temperate marine ecosystems so limits would be largely experimental https://www.nature.com/articles/s41598-021-82847-4	

		2. Close areas to potting	Pros as above for reducing impact (scale of impact may vary slightly)	Cons as above (scale of impact may vary slightly)	
		3. Switch to alternative fishing methods for crab and lobster	Pros as above for reducing impact (scale of impact may vary slightly)	Limited alternative methods that are as efficient as potting (and may be more damaging/less sustainable), so supply chains potentially disrupted (and environmental impacts not mitigated)	
		4. Switch to alternative fishing grounds for crab and lobster	Pros as above for reducing impact (scale of impact may vary slightly)	Affected fishers must spend time mitigating to avoid loss in income (new grounds/new gears)	
			Alternative fishing grounds available	Increased enforcement costs	
				Potential increase in conflict and competition due to large proportion of fleet being potters	
	<i>Mooring and anchor damage to sensitive habitats such as seagrass meadows</i>	1. Attach small floats along the chain of a traditional swing mooring https://www.nature.com/articles/s41598-019-55425-y	Small modification costs (~£800): https://www.nature.com/articles/s41598-019-55425-y		An eco-moorings working group has been set up recently and is being managed by Ports of Jersey. This is currently focussing on the seagrass meadows in St Catherines Bay on the east coast of the island and is looking to develop a system suitable for Jersey's large tides. They are also looking at creating no-anchoring zones to prevent damage in specific area(s).
			Experimental studies have shown seagrass density surrounding modified moorings was over twice as high		
		2. Introduce a code of conduct for fishers e.g.: https://www.rya.org.uk/e-news/inbrief/top-tips-for-anchoring-and-mooring-with-care	Develops a culture of trust and mutual respect, encourages participation in data and information sharing and engagement of other local relevant stakeholders in delivering objectives	Can take years to formulate through dedicated consultation process	
			Faster implementation than legislation	Compliance likely to be lower than legislation, non enforceable / no formal sanctions for non-compliance	
Target stock population	<i>Indications of stock decline in brown crab, lobster, whelk, bass and scallop</i>	Access rights:			
		1. Reduce fishing effort in key declining sectors	Pros as above for 'reduced intensity' (potting)	Cons as above for 'reduced intensity' (potting)	Declines reported in latest Jersey annual report (2019) https://www.gov.je/SiteCollectionDocuments/Environment%20and%20greener%20living/ID%20Marine%20Resources%20Annual%20Report%202019.pdf
		2. Implement metier/species-based permits where numbers are capped based on management measures (species/gear technical measures; quotas relating to catch and gear; conditions reflecting evidence of stock health)	Worked well in Normandy (French vessels are familiar) and Jersey Fishermens Association reported to be in favour.	Would require significant stakeholder consultation	Jersey needs to implement a management system that can be applied equally to French and Jersey fleets, is within TCA terms, and ensures fishery is sustainable and works in harmony with the marine environment and other areas of marine management.

			Can be linked to stock information/ iVMS and meaningful ecolabelling, marketing and other onshore initiatives	Brexit licencing arrangements ongoing and may delay implementation of further change in access rights			
		3. Introduce zonation (seasonal/permanent) for different issues such as conflicting metiers, damage to nursery grounds etc.	Separate conflicting metiers	Displacement of fishing activities to other areas and related impacts of exploitation			
			Safeguard productive environments and nursery grounds	Economic impact on fishers			
			Add value to key catches				
			Increase natural capital				
			Create marine wildlife corridors				
			Prevents over expansion of certain fisheries				
		4. Ecosystem approach to management rather than single species management for some species	Improved ecosystem resilience to negative change	Species-based management approach has been the focus for Jersey to date – would require additional data and tools, as well as potentially policy and regulatory frameworks			
			Cost effective management approach				
			Adaptive to change				
		Quota management:					
		1. Changes to quota management (annual/quarterly, not monthly) or more flexibility in quota system (rolling over of unused quota)	Accounts for seasonality and bad weather	Overall impact on stocks potentially greater	Limited market or fishery for quota species in Jersey		
			Quota not wasted	Significant managerial change required (decentralisation of quota allocation) so not a short-term option			
			Fisher safety improved as not chasing fish in poor weather				
			Jersey can sell more seasonal fish and can rely less on imports				
		Technical measures:					
		1. Gear design (e.g. lobster escape hatches, whelk holes, mesh sizes)	Already implemented for relevant fisheries in Jersey				
		2. Minimum landing sizes					
		3. Pot limits					
		4. Angling measures: bag and size limits for anglers, better use of appropriate tackle					
Voluntary measures:							

		1. Voluntary codes of conduct and MoUs for management measures (e.g. for zonation, technical measures, seasonal fishing windows etc)	Develops a culture of trust and mutual respect, encourages participation in data and information sharing and engagement of other local relevant stakeholders in delivering objectives	Can take years to formulate through dedicated consultation process		
			Faster implementation of required management measures than legislation	Compliance likely to be lower than legislation, non enforceable / no formal sanctions for non-compliance		
			Significantly reduced costs for Jersey Government			
		2. Fishers to police their peers (e.g. anonymous reporting system)				
		Improving science and data:				
		1. Improve speed at which data on fish stocks is incorporated into management decisions	Improved fisheries sustainability	Requires more resources (staff, time, equipment)	Some species currently do not undergo regular assessment / are data deficient	
			Allows management to be more reactive and more flexible for fishers			
		2. Sufficient monitoring of catches via appropriate sampling (landed weight; discards; effort; VMS; value chain data)	As above	As above		
		3. Sufficient monitoring of populations/stocks and habitats via appropriate sampling (scientific surveys, biological and physical sampling)	As above	As above		
		4. Fisher-science partnerships to understand mortality and seabed/ecosystem impacts	Foundation already exists with scientific working groups established under the GBA for purposes of data sharing, joint assessment and consultation	Requires buy in from all stakeholder groups to be effective		
May encourage links between French and Jersey fisheries if linked to mutual permitting system (described above)						
5. Annual fisheries reports at métier level to provide information on fishing effort	Already completed					
Supply chain:						

		1. Develop a fisheries marketing strategy for Jersey (market research into consumer preferences e.g. local vs sustainable, willingness to spend more, preferences for certain seafood products, identify the 'low impact' products)	By understanding the strengths, weaknesses, opportunities and threats in the existing supply chain, follow up actions are more appropriate and are more likely to be successful		
		2. Obtain a higher market value for fish caught in a 'low impact' manner	Consumer can be very powerful in contributing to sustainability	From initial market research, buying local was more important to Jersey consumers than buying sustainable so marketing of products will require careful thought to avoid further negative impacts on stock. Should be informed by marketing strategy.	Methods of increasing value addition (most common suggestions from stakeholders via MEP consultations in early 2021): 1. Improve public awareness of low impact fishing 2. Eco-labelling 3. Diversify the market to sell more of what is in season/what is currently sustainable/what is local. Potential options: <i>a) Improve links between fish merchants, buyers and fishers</i> <i>b) Set up Jersey Fishers Co-operative</i> <i>c) Restaurant scheme to sell more local fish and operate more seasonally</i> <i>d) Set up a processing centre on the island</i> <i>e) Support the Jersey Alternative Fish market</i> <i>f) Explore opportunities in the French export market</i> <i>g) Renaming fish</i> 4. Government economic support. 5. Increase competitiveness of Jersey market 6. Local food produce sections
				Seafood market in Jersey is majority export so impact of such events is uncertain	

				Low impact is not yet clearly defined/agreed and could be confused with sustainability metrics (although the two are not mutually exclusive)	
Bycatch and discards	<i>Not identified as an issue in Jersey as only one trawler operates</i>				
Plastic and pollution	<i>Ghost gear reportedly dumped at sea due to lack of capacity in onshore facilities</i>	1. Provide onshore facilities (easy to access in main landing harbours) with suitable capacity to dispose of/recycle fishing gear	Reduces plastic pollution in marine environment	Financial incentives/non-financial incentives/reward schemes may be needed to encourage use. Could incorporate low impact credits earned towards fishing rights or new fishing gear.	Dorset fishing gear recycling bins: https://bridport.nub.news/n/west-bay-fishermen-join-an-initiative-to-help-keep-our-seas-litter-free
		2. Reduce use of single use plastics in fleet	Single plastic use in fleet already reported to be minimal further reduction in use should be achievable	Alternatives potentially more costly/not often available	
		3. Reduce the use of plastic in trawl materials (e.g. replace dollies with braided rope)	Only one trawl vessel in fleet	None identified	
		4. Increased monitoring surveys of plastic pollution	Identifies true extent of problem	Requires resources and implementation may be slow as not identified as a major issue in Jersey	Could link with fisher peer policing of gear dumping
Fuel use	<i>Fishing vessels create carbon emissions, as along with onshore supporting services</i>	1. Improve fuel efficiency of engines in fleet	Most of the fleet is static and average fuel costs per day assumed to be generally lower than mobile fleets so not a major issue to solve in Jersey. https://www.seafish.org/document/?id=65eff039-7a67-4361-8094-792152b082d4	Requires prior assessment of fleet (age profile etc)	Fuel use is a major component of assessing the carbon footprint of a fleet but other factors, such as footprint of supporting land-based services and the impact of the fleet on blue carbon would also need to be considered for a full assessment.
		2. Grants to enable vessel owners to switch to low-carbon technologies for engines (e.g. hydrogen cell, diesel-electric hybrid engines)	May only need to apply to a few vessels	Requires resources to assess need and implementation may be slow as may not identified as a major issue in Jersey	
Fish welfare	<i>Belief that poor treatment of fish is unavoidable</i>	1. Education on fish welfare (e.g. handling to reduce unintended post-release mortality)	Future opportunity to add value as it does currently for 'high-welfare' land-based products.	Not identified as a major issue in Jersey (much of the fishery catches are live caught/landed) so may not get traction	Jersey have island-wide animal welfare laws but not sure how these apply to commercial fish/shellfish. There are specific regs and licence conditions (e.g. no live winging of rays).

		2. Implement various improved welfare practices such as limiting the time out of water, use of correct tackle and hooks (angling) and no live winging of rays (commercial)			More information in fish welfare discussions here: http://fishcount.org.uk/uk-strategy#5value
Other impacts	<i>Social impacts - uptake of young professionals into the Jersey fishing industry is low</i>	1. Sufficient monitoring of economic viability of the fishery via appropriate sampling allows managers to support where required	Allows appropriate support to be given to industry where required	Data often difficult to obtain (confidentiality) and current reliance on export market (lack of transparency)	
				Requires resources to collect data	
		2. Young fisher / new entrant incentive schemes	Important economic and cultural activity maintained for Jersey	Existing fishers may raise concerns as seen with the 2017 'new entrant scheme' in Jersey	
				Risky to introduce more fishing effort when stocks already under pressure Lack of experience may cause loss in revenue	

3. Conclusions

As evidenced by the diversity of components discussed above, any future definition of low impact fisheries will require further assessment of multiple environmental, social and economic criteria, and in specific local contexts. Until an official definition and associated criteria are adopted in the UK, localised fisheries such as those operating in Jersey waters can take sensible steps to reducing any known negative impacts from fishing on the local ecosystem and people it supports.

Using the low impact components outlined in this report as starting point for discussions, Jersey stakeholders could define what low impact fishing might look like for Jersey and identify locally appropriate criteria to be incorporated into a future fisheries management system. Williams et al., (2020) reported that fishers felt that a focus on *lower* impact, or lowering impact, was preferred, rather than *low* impact (which was deemed too absolute and inflexible). It was also strongly recommended by fishers that the real impact of the application of any definition of low/lower impact fishing should be considered before it is implemented. Finally, it should also be recognised that any form of fishing could have a high impact if there are too many vessels in a fishery, or effort is too high (when compared to defined environmental parameters). On the other hand, anything could be low impact if managed well in the appropriate location.

As shown by Table 1, low impact solutions to fisheries issues will have multiple environmental, social or economic costs and benefits. The pros and cons identified in Table 1 are by no means exhaustive and Jersey stakeholders should be given ample opportunity to consider and re-define them.

From the information gathered, Jersey fisheries are already operating in a relatively 'low impact' manner as some of the principles of low impact fishing (such as fuel usage, fewer discards, less bycatch) already align with the principles of running an efficient fishing business, so if typical barriers such as funding support for operational technology upgrades are limited or lacking, then relatively simple steps towards low impact fishing can be made. Other solutions identified that could feasibly be implemented in Jersey in the short term (no major barriers identified and suggested by multiple stakeholders) include:

- Implementing a revised permit-based fisheries access scheme (much of the Jersey and French fleets are operating in this manner already)
- Implementing further closed areas to demersal trawling if mitigation for affected Jersey fishers is feasible (alternative grounds in Jersey are readily available/alternative gears could be employed) due to the estimated potential gains in natural capital
- Increasing monitoring of the effectiveness of existing technical measures such as pot limits and minimum landing sizes
- Improving capacity for gear recycling facilities on the island
- Setting up a fish processing centre on the island
- Setting up educational events on low impact fishing and low impact products (including stakeholder workshops on defining low impact fishing in the Jersey context)
- Conducting a detailed fisheries marketing review potentially leading to the development of a Jersey fisheries marketing strategy

- Formalisation of a low impact fishing multistakeholder working group on Jersey (or expansion of existing group) which can in turn develop an Integrated Low Impact Fisheries Management Plan for Jersey.

Other low impact solutions identified will likely take longer to implement in Jersey due to economic and political barriers. These include:

- Defining low impact criteria for Jersey fisheries. Once implemented, and as suggested in Williams et al., (2020), Jersey may wish to consider implementing a points-based low impact reward system where fishers can earn points for activities that are deemed low impact, such as recycling fishing gear, trialling low impact labelling, evidence of application of voluntary codes of conduct, etc. The appropriate elements for achieving points could be set out in a Low Impact Code of Conduct for different fisheries. Once a certain number of points are achieved, rewards for obtaining low impact status could include, for example, subsidised vessel maintenance, free access to island processing facilities or partnerships with supermarkets for seafood concessions.
- Implementing a zonation system for different fisheries (and potentially other marine activities) around Jersey
- Diversifying away from the current high dependence on continental exports by bringing the bulk of catch from the numerous small and medium size boats and metiers, to a centralised location on Jersey. Prices on Jersey, and the supply chain system have remained relatively unchanged for a long time, and there needs to be real incentive and need to implement change. This can only be informed from a detailed fisheries marketing study and economic feasibility assessment. It is suggested that the supply chain value addition options discussed above are incorporated into the process.

Based on our investigations, some general considerations for implementing a future low impact model in Jersey should consider that any changes are:

- **Fair** – criteria are applied across the board (to all fleets and metiers)
- **Evidence based** – sufficient levels of primary and secondary data are collected and analysed, upon which new management measures can be justified and survive scrutiny. This in turn is more likely to lead to meaningful and enforceable legislation. For example, both the quantifiable *and* qualitative perceived benefits of removing/reducing fishing effort must significantly outweigh the impacts on the supply chain and incomes.
- **Risk-based**: given limited resources, the choice to implement certain measures must achieve maximum gains relative to defined fisheries management objectives.
- **Continuously monitored for their impact** – it is important that the impacts of changes are monitored regularly to identify faults in the system and modify management as necessary. This maintains trust amongst stakeholders and allows for a more effective management system.
- **Ecosystem based** – changes implemented should consider multiple ecosystem impacts and benefits, in order to achieve a more resilient fishery in the long term. For example, incorporating natural capital into economic impact assessments and objectives, or considering all compounding stressors to the marine ecosystem (such as aggregate extraction, aquaculture and tourism) and not just the impacts of fishing.
- **In line with co-management principles** – implementing regulatory, policy or operational changes will better facilitated by stakeholders working collaboratively to

define them or are at least involved in discussions surrounding them. Co-management supports a flexible management system and may encourage fishers to experiment with gears that are less deleterious, for example. However, this is only if changes to regulations/policy include fishers in planning and they are given greater responsibility, as it is they who have the knowledge to know what is feasible.

- **Correctly timed** – if conservation objectives are not likely to be severely compromised, in general, a gradual change in implementing new management (e.g. starting with voluntary measures, or slowly phasing in a zonation scheme/effort limits/closed areas over a number of months/years) is favourable, giving stakeholders time to be consulted and accepting of the change. Gradual implementation also allows for better monitoring of whether changes are effective or require amendment. Even small changes can achieve noticeable gains in ecosystem health.

4. References

Gall, S.C., Rodwell, L.D., Clark, S., Robbins, T., Attrill, M.J., Holmes, L.A. and Sheehan, E.V., 2020. The impact of potting for crustaceans on temperate rocky reef habitats: Implications for management. *Marine Environmental Research*, 162, p.105134.

Luff, A.L., Sheehan, E.V., Parry, M. and Higgs, N.D., 2019. A simple mooring modification reduces impacts on seagrass meadows. *Scientific reports*, 9(1), pp.1-10.

Sala, E., Mayorga, J., Bradley, D., Cabral, R.B., Atwood, T.B., Auber, A., Cheung, W., Costello, C., Ferretti, F., Friedlander, A.M. and Gaines, S.D., 2021. Protecting the global ocean for biodiversity, food and climate. *Nature*, 592(7854), pp.397-402.

STECF (2007). Climate friendly, low impact alternatives. Seas at Risk, North Sea Foundation report. Available at:

https://stecf.jrc.ec.europa.eu/c/document_library/get_file?uuid=924c1ba8-94af-440d-94cb-f9cb124d2d57&groupId=12762

Williams, C., Arthur, R., Owen, H., Urquhart, J., Chiswell, H. and Muench, A (2020). Defra Low Impact Fishing Co-Design Project. Phase 2: Final Project Report.