

A report for the Marine Management Organisation

**The social impacts of marine conservation zones on the North
Devon inshore fishing fleets**

Siân E. Rees and Lynda D. Rodwell

The Centre for Marine and Coastal Policy Research, Plymouth University

January 2012

1	List of figures and tables	3
2	Executive summary	4
3	Introduction.....	5
4	Methods	13
5	Results	15
6	Discussion.....	31
7	Recommendations	32
8	Conclusion.....	35
9	Acknowledgements	36
10	References.....	36

1 List of figures and tables

Figure 1 Case study area.....	9
Figure 2: The home ports as stated by the respondents.....	16
Figure 3: Respondents' gear type and boat length (metres)	17
Figure 4: Number of fishing trips taken by fishing vessels in a year and per season.	17
Figure 5 The number of respondents targeting each species by season	18
Figure 6 The respondents mean turnover by gear type.	19
Figure 7 The proportion of expenditure across the subcategories for static and mobile gear fishermen.	20
Table 1: The rMCZ site management measures	12
Table 2: The age range of the respondents	15
Table 3 A thematic framework of the potential impacts of the rMCZs and the Atlantic Array on the fishing industry.....	26
Table 4 A thematic framework of the potential strategies that the respondents will adopt to adapt to the proposed changes.	28
Table 5 A thematic framework of the respondents' suggestions for the future management of the fisheries in the North Devon Biosphere reserve area.....	29

2 Executive summary

The implementation of an MPA creates a need for fishermen to adapt fishing practices. The change can therefore impact (both positively and negatively) upon the fishing community. MPA managers who miss out the social context in management decisions and fail to acknowledge the unique nature of fishing activities and responses to change are risking the future ability of MPAs to meet all stakeholders' needs. To inform management this research uses a structured interview methodology to gain quantitative and qualitative data from fishermen operating in a case study area, North Devon. This study has demonstrated that the marine environment in North Devon supports a small scale, profitable fishing industry where the well-being of the respondents is linked to their fishing activity. The fishermen who were respondents to this study are mostly positive about marine conservation in general, however the recent proposals for a wind farm development (The Atlantic Array) within an MCZ and no agreed management regime for the MCZs have added an element of uncertainty about the future and this has distanced these fishermen from the wider planning process. The interviewed fishermen identified the potential social impacts, potential strategies to adapt to the change and possible mechanisms for managing the MCZs in the North Devon Area. To maintain a sustainable industry there is a need to align the MCZ objectives with fishery objectives and possibly create systems for the co-management of marine resources supported by collaborative monitoring programmes.

3 Introduction

Marine protected areas (MPAs) and MPA networks are recognised as being an effective and necessary conservation tool for protecting marine biodiversity and providing a base for the sustainable management of marine resources (Kelleher 1999; Sobel & Dahlgren 2004). In response to international and European drivers for MPAs (European Community Council Directive 1992; OSPAR Convention 2002; Secretariat of the Convention on Biological Diversity 2004) the UK Administrations are tasked to substantially complete an ecologically coherent network of MPAs by 2012 (HM Government 2011). To support the UK Government in meeting these international and European commitments and to achieve the Government's aim of 'clean, healthy, safe, productive and biologically diverse oceans and seas' (Defra 2002) the development of the Marine and Coastal Access Act (MCAA) (HM Government 2009), and the Marine (Scotland) Act (2010), and the forthcoming Northern Ireland Marine Bill (2012) are providing the legal frameworks to develop Marine Plans (guided at a national-level by the Marine Policy Statement (HM Government 2011)), and enable the designation of a new type of Marine Protected Area (MPA) called a Marine Conservation Zone (MCZ).

An extensive stakeholder consultation process (2007 – 2011) was undertaken to define the location of the new MCZs to network with existing MPAs. These existing MPAs constitute the European *Natura 2000* sites (Special Areas of Conservation (SAC), Special Protection Areas (SPAs), enabled under the EC Birds Directive 79/409/EEC and Habitats Directive 92/43/EEC and Marine

Nature Reserves (MNRs) enabled under the Wildlife and Countryside Act 1981. (European Community Council Directive 1992).

Recommendations for MCZs (rMCZs) were published in September 2011 (Balanced Seas 2011; Irish Sea Conservation Zones 2011; Finding Sanctuary, Leiberknecht et al. 2011; Net Gain 2011). These recommendations are currently under review by an independent scientific advisory panel and the statutory nature conservation agencies. Final recommendations will be put forward to Government in 2012 and the rMCZs will be subject to a public consultation and a review of the evidence base.

3.1 Fisheries and MPAs

The benefits of MPAs for some fisheries are well recorded in the scientific literature (Halpern et al. 2009; Jennings 2009; Lester et al. 2009; Roberts et al. 2001). However, the results of such studies to support the premise that MPAs benefit wider fisheries management remains controversial (Brady & Waldo 2009; Degnbol et al. 2006; Hilborn et al. 2004; Jones 2007). It is noted that whilst MPAs have strong support within conservation policy there is less support for MPAs in conventional fisheries management as a tool for improving fish stocks (Jones 2007). MPAs are primarily a conservation tool that are necessary to maintain wider biological diversity upon which the delivery of ecosystem services and therefore human wellbeing depend (Millennium Ecosystem Assessment 2005). Whilst it has been demonstrated it is possible to build MPA networks to include multiple stakeholder interests, and not compromise biodiversity goals (Klein 2007) the conflict arises between conservation objectives and fisheries objectives

because MPAs limit extractive activities and the use of specific gear types. Fishermen are used to working in a dynamic environment and from a social perspective they have been shown to be adept at developing and implementing fishing strategies in response to imposed constraints in line with the parameters of their cultural, social and economic contexts (Salas & Gaertner 2004). The implementation of an MPA creates a need for fishermen to adapt. The change can therefore impact (both positively and negatively) upon the fishing community (Mascia et al. 2010; Rees et al. 2010). These impacts can have economic, social and environmental consequences that, if unaddressed in the onward management process of the MPA, can have detrimental effects on both the ecological gains associated with MPAs and the lives and livelihoods of those that depend on the resource (Agardy et al. 2011; Christie 2004; Christie et al. 2003; Klein et al. 2008; Leleu et al. 2012; Mascia et al. 2010; Pollnac et al. 2010; Rosendo et al. 2011).

3.2 Social Impacts and MPAs

The conservation gains associated with MPAs cannot be achieved without the support of fishermen and long-term sustainable fisheries cannot be achieved without wider habitat conservation measures. Ultimately the two are linked, the social-ecological system (Pollnac et al. 2010). Therefore, it is the response of fishermen to an MPA designation (including their perceived legitimacy of the planning process) and how they are engaged in the onward management process of an MPA that can determine the success or failure of an MPA. The planning of MPAs has largely focussed on ecological systems and broad brush economics and largely left out the social context (Rees et al. 2010). Fisheries science is similarly weak on social impact assessments as

studies are founded in ecology via stock assessments and makes use of economic modelling (Symes & Hoefnagel 2010).

Being a fisherman is a powerful and specific form of identity relating to the self, place and the community (LiPuma 1992; Urquhart et al. 2011). Informal property rights amongst fishermen can be strongly embedded in the day to day fishing operations (Jentoft et al. 1998). From a social perspective it is known that MPAs can influence fishermen's well-being in relation to earned income, resource rights, employment (both upstream and downstream) and community organisation (Mascia et al. 2010). Individuals are known to base their decisions within a social context (Videras et al. 2012). The social context in relation to fisheries is however complex and often simplified when management policies are defined (Salas & Gaertner 2004; Urquhart et al. 2011). It is known that the success or failure of an MPA can be influenced by how the perceptions and behavioural response of fishermen to MPA designations are understood and ingrained in the policy approach (Lédée et al. 2012; Symes & Hoefnagel 2010). MPA managers who miss out the social context in management decisions and fail to acknowledge the unique nature of fishing activities and responses to change are risking the future ability of MPAs to meet all stakeholders needs (Agardy et al. 2011; Voyer et al. 2012). Therefore the analysis of the social impacts of MPAs may have significant impacts for policy development (Mascia et al. 2010).

3.3 Case Study Area – North Devon (The Bristol Channel) and the North Devon Biosphere Reserve

This study is focussed on the North Devon area (Figure 1) where fishermen operate from North Devon ports (within the Biosphere) to fish areas both within the North Devon Biosphere Reserve and further out into the Bristol Channel.

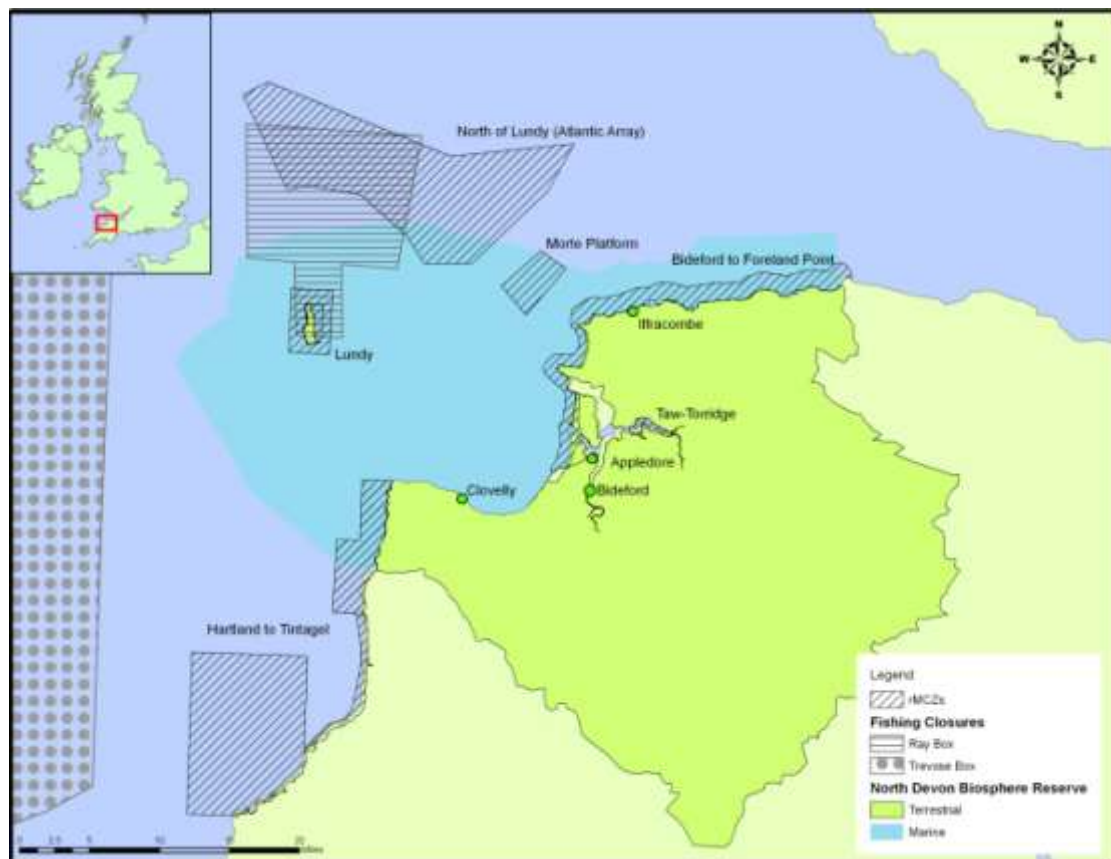


Figure 1: Case study area

World Biosphere Reserves are designated by United Nations Educational and Scientific and Cultural Organisation (UNESCO) as sites of high biogeographical importance and serve as learning laboratories for to demonstrate sustainable development on a regional scale. The North Devon Biosphere Reserve, designated in 2002, is an example of an area of world class natural value (North Devon Biosphere Reserve Service 2008) for its

marine and terrestrial ecosystems. Some of the special features for which the biosphere was designated from a marine perspective include an area rich in marine biodiversity that includes the UK's first no-take Marine Protected Area at Lundy Island (Hiscock & Breckels 2007); flagship marine species such as common dolphins, porpoises, grey seals, basking and porbeagle shark and a locally significant fishing industry (North Devon Biosphere Reserve Service 2008).

The geographical area of North Devon which includes the North Devon Biosphere Reserve was chosen for this social impact case study as the region not only supports world class biodiversity but also a small, organised fishing community represented by the North Devon Fisherman's Association (NDFFA). The fishermen in this region have operated for years with marine conservation measures in place to support the sustainability of the local fishing industry. These measures include Lundy Island no take zone (established under a fisheries by-law in 2003). In addition, there are local fisheries measures in place that support conservation and sustainable development. These include the 'Ray Box' which is an area in excess of 300km² that is closed via voluntary measures (1st December to 31st May) to protect juvenile ray and spawning stocks and the 'Trevose Box' is an area which is closed to all vessels (including all EU fishing vessels) between February and March as part of a cod recovery plan.

To meet international, European and national requirements for wider marine conservation measures, the output of a period of stakeholder consultation has

resulted in six MCZs being proposed within the case study area as part of the wider MPA network. These are:

- Hartland to Tintagel;
- Lundy;
- Bideford to Foreland Pt;
- Morte Platform;
- North of Lundy (The Atlantic Array); and
- The Taw Torridge Estuary.

The recommended MCZs (rMCZs) contain areas of benthic broadscale habitat that contribute the UK network along with representative examples of Features of Conservation Interest (FOCI) (Ashworth & Stoker 2010). The North of Lundy (The Atlantic Array) rMCZ is being considered for co-location with a wind farm development. It has been noted that the most significant uncertainty of the MCZ process to-date is the lack of statutory guidance relating to the onward management of the proposed sites (Leiberknecht et al. 2011). Table 1 summarises the management measures recommended to UK Government for these North Devon sites.

Table 1: The rMCZ site management measures recommended to UK Government by the Finding Sanctuary project team (Leiberknecht et al. 2011).

	No bottom trawl	Partial closure to bottom trawls	No static gear	Possible limits on static gear	No-take zone	Partial closure to pelagic nets
Hartland to Tintagel		X		X		X
Lundy	X		X	X	X	
Bideford to Foreland Pt		X		X		
Morte platform		X		X		
North of Lundy (Atlantic Array)		X		X		
Tor Torridge Estuary	X		X			

These upcoming rMCZs, and the on-going reform of the Common Fisheries Policy (CFP) (European Commission 2011) have been identified as presenting a challenge to the local fishing community. The fishing industry needs to adapt to meet the requirements, whilst at the same time maintaining a profitable and sustainable fishing enterprise (North Devon Fisheries Local Action Group 2011). As social and ecological systems are linked there is a need to understand and manage the transition. An analysis of the social impacts in this case study area will therefore help support the aims of the North Devon Biosphere Reserve to enable the development of communities where people live and work sustainably within an area of high environmental quality (North Devon Biosphere Reserve Service 2008). It will enable the NDFA to represent fisheries interests at local, regional and national meetings. It will also feed into proposals being developed by the North Devon Fisheries Local Action Group (FLAG) to prepare a stakeholder led strategy for the 'sustainable development of the areas fishing communities and to provide a

framework for a local funding programme through Axis 4 of the European Fisheries Fund.

3.4 Aims and objectives

The aim of this research is to achieve an understanding of the potential social impacts of the rMCZs on the inshore fleets operating in the North Devon case study area. For the purpose of this study social impacts are defined as those potential impacts of the rMCZ as perceived by the interviewee. These impacts may be economic, social and/or ecological in nature but ultimately are expressed by the interviewee as impacting on well-being (social impacts). To inform management and contribute to the wider debate surrounding social impacts and MPAs this research uses a case study area to determine the following objectives to:

- provide a baseline (current level of activity and returns) prior to the setting up of the network of Marine Conservation Zones (MCZs) in 2012; and to
- make recommendations on how social impacts can be addressed in the management process.

4 Methods

In order to achieve a greater understanding of the potential social impacts of the rMCZs and the Atlantic Array on fishermen operating in the North Devon case study area, we developed a questionnaire that combined both quantitative and qualitative question formats (open ended) to: 1) define the fishing activity; 2) explore the perceived social impacts and options for management; 3) document the economic sustainability of the fleet; and 4) define the socio-demographics of fishermen.

The questionnaire was developed, piloted and then approved by Plymouth University's ethics committee. Interviews took place between December 2011 and January 2012. Interviews were carried out by Spike Searle (Marrok Marine). Spike is an ex fisherman and has previously worked as a liaison officer with Finding Sanctuary and is currently a Discard Officer with the Centre for Environment, Fisheries and Aquaculture Science (Cefas). Spike was subcontracted by the University to conduct the interviews along with Reece Woolgar who is working under the guidance of Spike Searle and Sian Rees to gain experience in the fishing industry. Responses to the open ended questions were recorded to enable a detailed transcription. Contact with interviewees (NFDA and interviewer fishing contacts, n=13) was made through the NDFA or by contacts made through the interviewer. Interviews were conducted either by telephone or face to face. The interviewers were tasked to elicit responses to the open ended questions and (if necessary) provide a set prompt to steer the answer. A sample size of 77% was achieved (10 out of 13).

4.1 Data analysis

Quantitative data analysis was undertaken using Microsoft Excel. Where data is presented in an aggregated format (e.g. earnings and catch) averages are provided. Where a range of values were given e.g. earnings between £45,000 and £50,000 the mid-point was used for analysis.

Qualitative data were extracted and analysed using the text analysis software NVivo8 (QSR International 2010) which enables analysis of open ended responses and allows coding of themes. The analysis involved coding responses into a thematic framework, the themes of which were based on the question asked and the themes raised in the interviewees' answers.

5 Results

5.1 Description of respondents

Ten fishermen were interviewed for the purpose of this study. This represents a very high response rate of 77%. All respondents were male. The age range represented in this study is shown in Table 2. The average number of years each respondent has spent in the fishing industry is 25.4years (sd= \pm 6.5 years). All respondents have completed either a basic secondary education or completed a level of education equivalent to a diploma, vocational or technical training.

Table 2: The age range of the respondents

Age	18-24	25-34	35-44	45-54	55-64	Over 65
Number of respondents	0	2	3	2	1	2

5.2 Description of fishing activity

The majority of respondents state that Ilfracombe is their home port (Figure 2). Other boats are based at Bideford, Clovelly and Appledore.

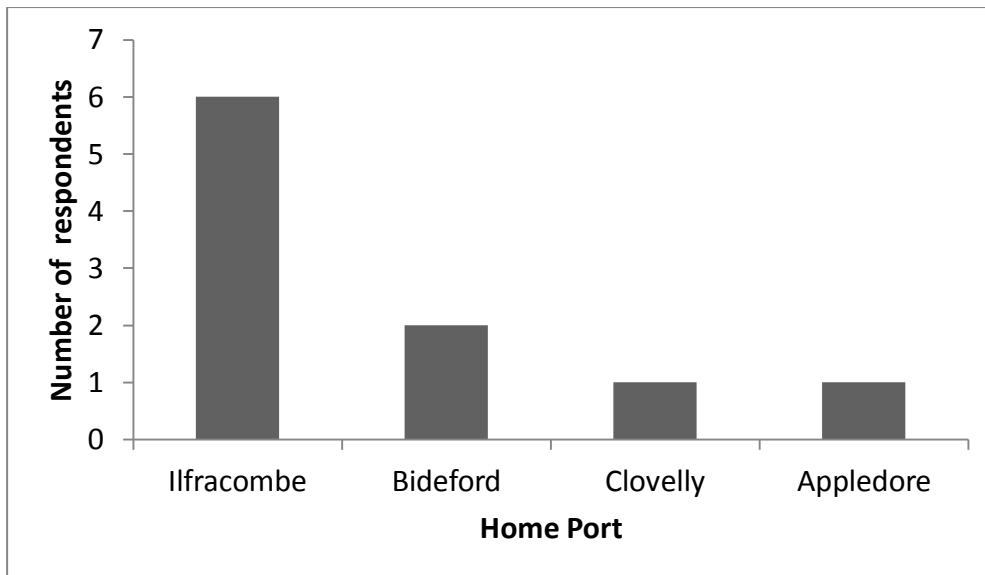


Figure 2: The home ports as stated by the respondents

Fishing takes place throughout the year with approximately 1794 fishing trips taken. It is recognised in this study that several of the respondents spend several days at sea at a time so for the purpose of this study 'fishing trips' is defined as either the act of leaving the home port (a fishing trip) for 0-24 hours fishing and/or the number of days at sea (without returning to port). The fleet is made up of potting boats (static gear) that are predominantly under 12m (6 respondents) and trawlers (mobile gear) that are all between 12-24m (Figure 3).

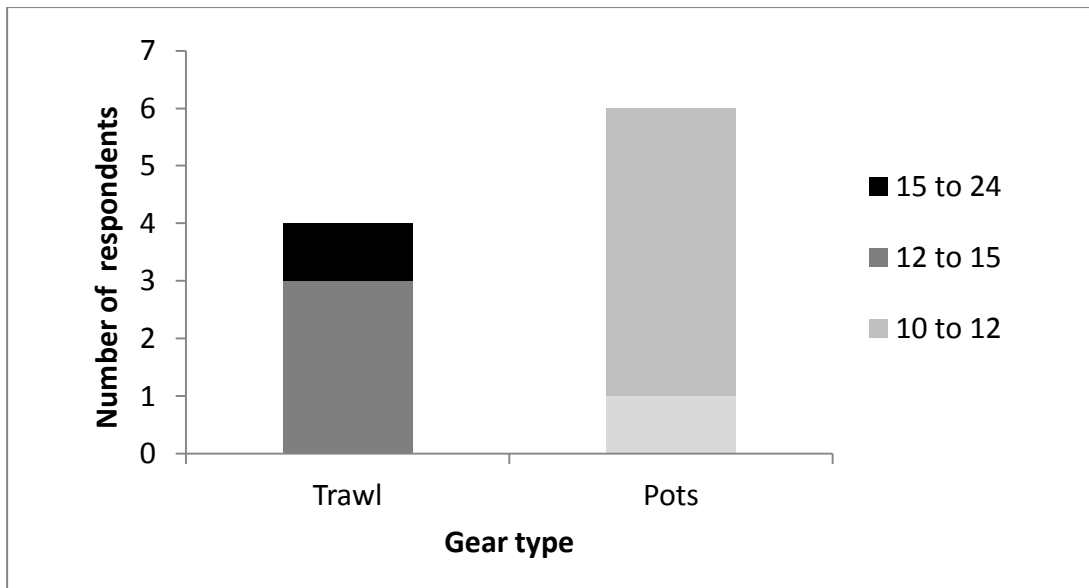


Figure 3: Respondents' gear type and boat length (metres)

Each fishing boat takes an average of 179 fishing trips a year (sd= \pm 31).

These trips are spread throughout the year with the most effort taking place in the spring and summer months (Figure 4).

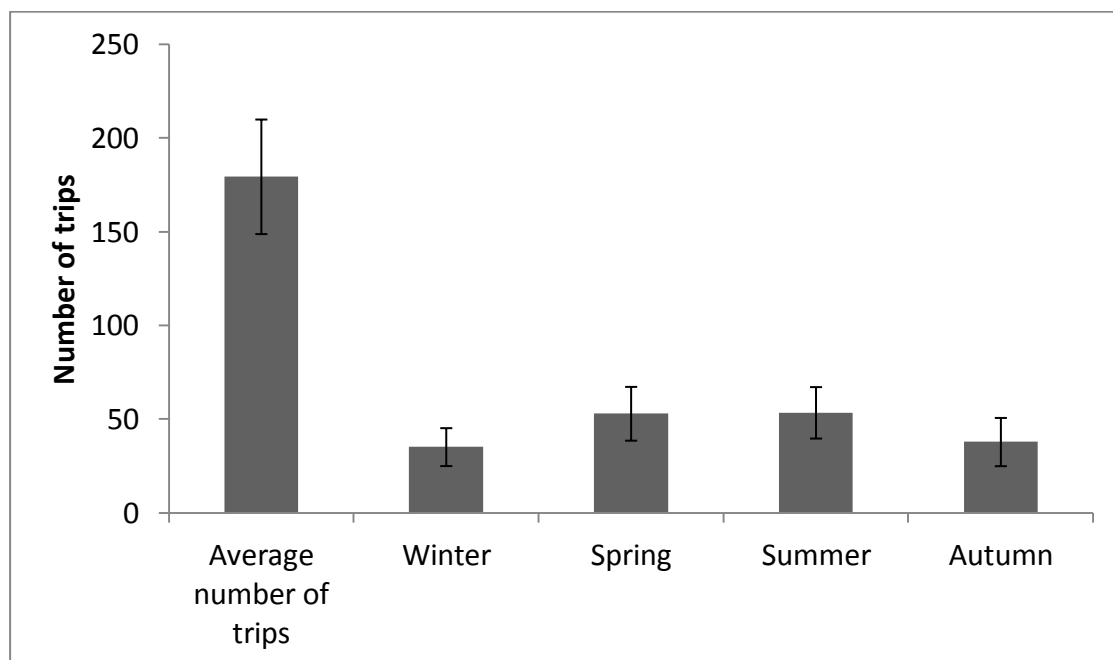


Figure 4: Number of fishing trips taken by fishing vessels in a year and per season. Results presented as the mean number of fishing trips and the standard deviation from the mean.

Mobile (mainly otter trawls) and static gear (pots) are used by the fishing fleet to target marine species (Figure 5). Shellfish such as crab, lobster and whelks are landed all year round and for this group of respondents, constitute the main source of income. Mobile gear is used to trawl for species such as rays and sole. Cod, haddock, bass, john dory and squid are also seasonal catches. One respondent has recently diversified his fishing activity to include using mobile gear to dredge for scallops. So far he has completed one autumn and winter season but aims to target scallops all year round.

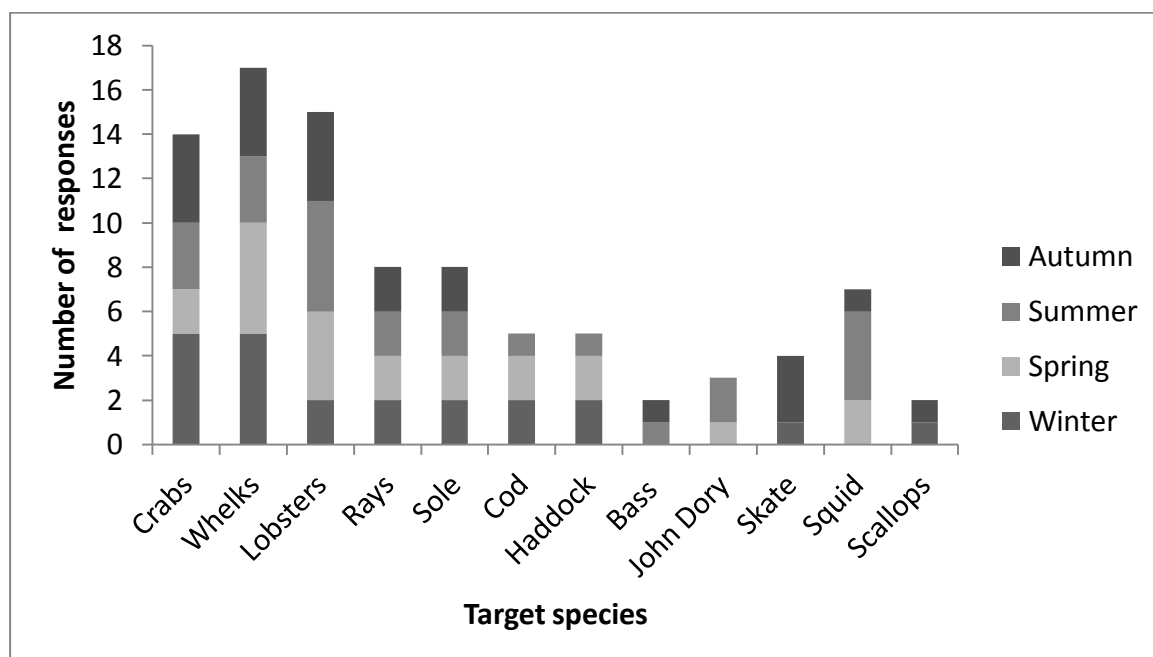


Figure 5: The number of respondents targeting each species by season

5.3 The fleet economics

Respondents were asked to indicate what was the approximate annual turnover (sales from landings) generated from their fishing enterprise. The combined approximate value of landings through local ports is approximately £2,055,000 per year. The average turnover by gear type is shown in Figure 6.

Results are divided by gear type to reflect the differences in the way the boats operate rather than provide a direct comparison between gear types.

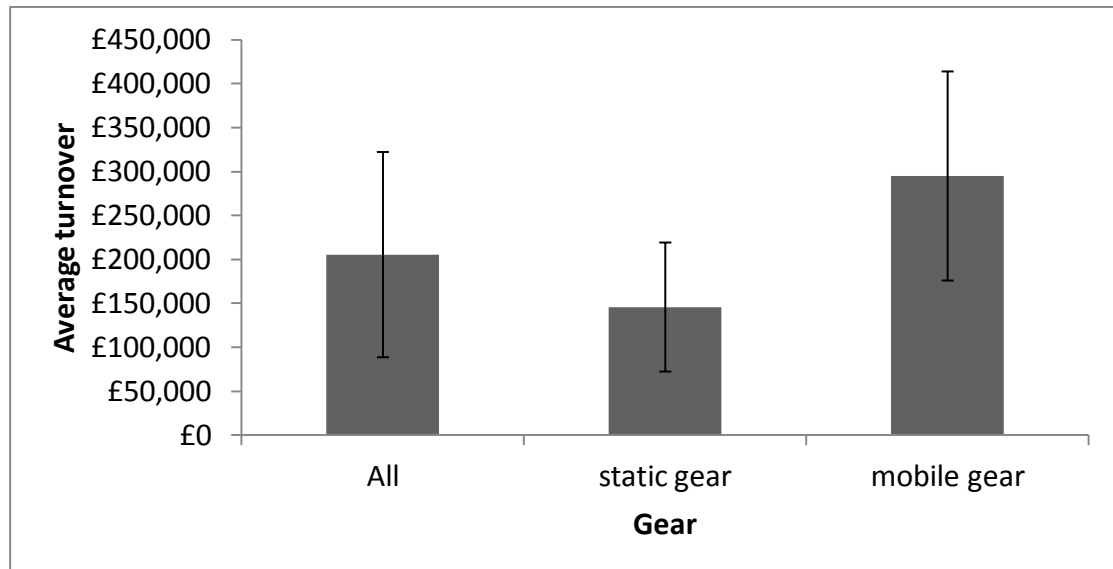


Figure 6: The respondents mean turnover by gear type. Results presented as the mean and the standard deviation of the mean.

Expenditure on the business is approximately 63% (sd= \pm 6%) of the turnover for static gear fishermen and 86% (sd= \pm 9%) of turnover for mobile gear fishermen. The proportion of expenditure across the subcategories is shown in Figure 7. It can be seen that the largest expenditure by these fishermen is on crew wages. A crew share of the net profit is approximately 20% on both mobile and static gear boats. The low deviation from the average percentage expenditure of mobile and static gear fishermen in the subcategories of fuel costs, harbour dues, gear and maintenance and crew wages demonstrate that at present these costs are relatively fixed. The broader standard deviation demonstrated in the capital payments, quota and other subcategories demonstrates that these costs vary from fishermen to fishermen based on the level of risk and investment in the business enterprise.

In addition to the expenditure on the business all of the fishermen stated that they receive a government funded subsidy (reduction in duty) of approximately 16% of their total expenditure on fuel.

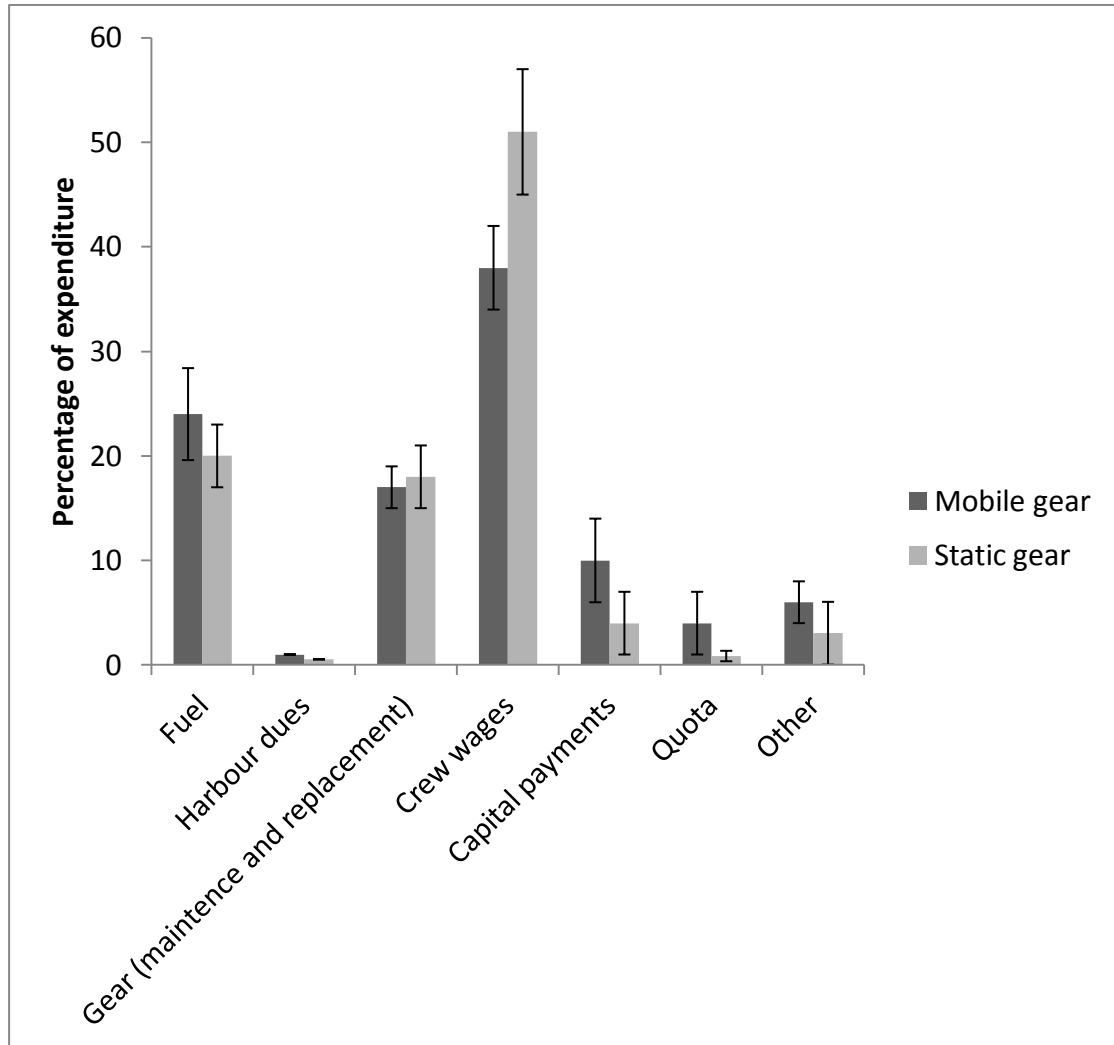


Figure 7: The proportion of expenditure across the subcategories for static and mobile gear fishermen. The chart shows the mean percentage expenditures across subcategories and the standard error of the mean.

In the last year 60% of the respondents stated that they had seen an increase in income in the last year due to increasing effort and investment in gear. 20% responded that their income had declined last year as a result of diversifying fishing practices and a decline in the landing value for lobster. 20% of respondents stated that their income had stayed the same.

90% of respondents stated that family members were involved in their fishing business. 40% had one family member involved and 50% had two family members involved. Family involvement in the business includes the role of wives in the book keeping and sons, son in laws and nephews working on the boats.

None of the respondents were in receipt of government fishing subsidies other than fuel subsidies. 40% of the respondents had additional means of earning income these include involvement in property management and running a local restaurant business. Two of the respondents were in receipt of a pension.

5.4 The general feeling within the fishing community

Answers to this question were sorted into positive and negative comments. Of the 32 comments recorded 20 were negative responses and 12 were positive responses. Positive comments relate to the fact that fishing enables the respondents to earn a living, *'It's an excellent living'* (F4). In addition 50% of the respondents commented that this year has been a particularly good year in terms of earnings and landings with, *'I think everybody was contented with having a good year in this last year'* (F7) and, *'I think people have got good vibes to go to fishing especially in this last year, because obviously the volume has been landed'* (F8). One respondent also stated that being involved in conservation projects (e.g. the lobster hatchery) and seeing, *'all these little lobsters are on the ground'* (F5) adds a positive element to fishing in this area.

Negative comments largely relate to uncertainty over the future and the impact on being able to earn a living, *'I wouldn't want to be driven out of what we've always done'* (F7). This uncertainty stems from previous experience of changes to fishing rights and regulations *'I used to go sharking and then they banned that then went over to spurdogs and then they banned that within two years'* (F9). There is therefore apprehension and uncertainty over what regulations will accompany the development of the MPA network and the development of the Atlantic Array, *'If they keep taking fishing opportunities away, you know, that's when it starts worrying me'* (F4).

Since entering into negotiations with other regional stakeholders as to the location of the MCZs there is a perception that the context of the discussion had changed and this adds to the feeling of uncertainty over the future, *'Two, three, four of us attended all the meetings, you know? I believe in trying to keep the fishing going, you know'* (F4) and *'The biggest problem we find is that we have objectives, and all of a sudden you go to a next meeting, and you find that Natural England, they changed the goal post yet again. They bring in things like...reference areas'* (F10). Negative comments from the respondents also relate to factors that have affected profit margins in the last year such as fuel prices and gear/mechanical failure.

5.5 Fishing and well-being

The respondents identified a number of ways fishing for a livelihood influences well-being. There is a perception that fishing is more than a job, *'it's not a job, it's just what I've done; it's our lives, you know?'* (F4). Fishing

influences family life due to the need to be able, *'to go with the tide'* (F2) and *'when the weather's right I go, you know?'* (F9). This commitment to fishing means that for many fishermen, *'Monday is no different to a Sunday. It's just the way of life'* (F1). Time spent away from home means that family life has to adjust to the routine, *'Most families are used to it'* (F4) and *'I was fishing when I first met my wife and we've been married 25 years, so it can't be that bad, can it?'* (F9).

The act of fishing is also linked to happiness, *'it's a lovely life'* (F7) and, *'I go to sea because I enjoy going to sea. Wake up in the morning when the sun is rising up, just been creeping up over the water, and it's a lovely calm day and there's lobsters and crabs coming aboard. You've got dolphins jumping around you. I get great pride in...it's not the money, it's about being on the boats at sea, seeing it all work, you know?'* (F8). Fishing is also linked to a sense of purpose, *'I'm doing the job I left school to do; I left school to go fishing'* (F8).

The negative aspects of fishing related to well-being are focused on the running of a business, *'I've got a responsibility to my crew you know? They've been with me some time now, especially the skipper. I want to keep them in work'* (F10). These include the time spent doing paperwork, the need to pay crew wages and working on a tight profit margin, *'There's a lot of pressure. You've got...to make a fair bit of money now because of the fuel the prices'* (F6).

5.6 Fishing and future business

All of the respondents gave statements that indicate that they would like to continue to invest in their business. This investment would enable the modernisation of equipment, and enable the purchase of more boats. The motivation for wanting to invest was, for many respondents, the desire to provide a business opportunity for their sons, *'Yeah, there's a good future in selling fish, I'm sure. You know, demand is showing that. You know, we've got young blood coming into it who want to do the job, you know? It would be nice to hand that over to the next generation to have a go, you know?'* (F4). Two of the respondents noted that during this period of uncertainty over the rMCZs and the Atlantic Array, planning and therefore investment is difficult. One respondent has taken an opportunity to start a local enterprise of selling his catch locally.

5.7 Perceptions on conservation, the rMCZs and the Atlantic Array.

90% of the respondents provided statements in favour of conservation measures, *'I think in the right places they could be really good'* (F1). Positive statements were made about the existing conservation measures at Lundy, *'what's already there is quite good, there is lobsters there, you know, they have spread out.'* (F2) and, *'We caught them [lobsters] moving off that area'* (F3). It is however the scale and size of the proposed network which is causing consternation, *'I can see some benefits, you know, of protecting areas. But it's the volume of areas and where they put them is my argument'* (F4). Support for conservation though is linked to the proposed management measures, *'All conservation zones are ok if they let us do static fishing and*

then only ban trawl fishing round areas, if they ban static fishing we might as well just go home now really (F3) and, 'Obviously, from the static gear fisherman's point of view. I think that's a good job from my point of view, but the trawler men obviously are not happy' (F8).

The proposal to development the North of Lundy rMCZ into the Atlantic Array windfarm was not supported by any of the respondents. Comments were provided from a conservation perspective, *'Protecting the habitat? Well how can you protect a habitat if you're going to pull millions of tonnes of gravel and stuff over the [seabed]? They're going to plough up the sea, digging up, putting cables in. Once it's been built, I can possibly see [advantages], but you've changed the habitat, you're not protecting it, you've completely changed the habitat from what it was' (F4).*

5.8 Impacts on the fishing industry

All of the respondents perceive that there would be impacts on the fishing industry from the proposed network of MCZs and the Atlantic Array.

Statements were analysed according to gear type (Table 3).

Table 3: A thematic framework of the potential impacts of the rMCZs and the Atlantic Array on the fishing industry. Responses are shown as the number of fishermen who provided comments provided under each theme.

Themes for potential impacts of rMCZs	Gear Type = Pots	Gear Type = Trawl	rMCZ or Atlantic Array (AA)
1 : Displacement	3	2	rMCZ and AA
2 : Gear conflict	3	2	rMCZ and AA
3 : Impact in the whelk fishery	4	1	AA
4 : Impact on elasmobranchs (shark, skate and rays)	0	1	AA
5 : Impact on lobster fishery	3	0	rMCZ and AA
6 : Impact on the squid fishery	0	1	AA
7 : Increase risk to personal safety (travelling further in small boats)	1	0	rMCZ and AA
8 : Increased costs (more gear, more fuel)	3	2	rMCZ and AA
9 : Loss of opportunity (less area to choose from)	2	3	rMCZ and AA
10 : Increased pressure on grounds and stocks	5	3	rMCZ and AA
11 : Unemployment (if whelking is no longer viable)	1	0	rMCZ and AA

The perceptions on the rMCZs and the Atlantic Array are linked across gear types. The predominant perception is that the new management measures in the MCZs and the development of the AA will cause increased pressure on existing fishing grounds and fish and shellfish stocks, *'I think you will then get a situation where you're going to get a lot more pots on the seabed and then that's going to upset the balance, which is ticking along I think very nicely in the North Devon area'* (F8) and, *'You get any more turn up here, with...who can fish the same areas as us, that will just...well, that would destroy us as well'* (F5). It could also cause habitat damage elsewhere, *'I reckon in fact that it probably would do more damage in the environment because you've then got to try and open up another bit of ground'* (F4). Increased pressure is naturally linked to the perceived displacement effects of reducing areas available to fish

or placing a limit on the number of pots that can be set in the rMCZs, *'I think the impact on inshore fishermen like myself, where the bigger boats, if they get pushed out of areas...wind farm sites, reference zones, or no-take zones, then you get a knock-on effect where you'll get bigger boats moving in areas where the smaller fisherman can only work because of the size of the craft'* (F8). Displacement and increased pressure on grounds are linked to the perceived impact of gear conflict, *'We're seeing more and more pots where we didn't used to see them. So if we're told that we can't go somewhere, we're going to have to try and open up more ground which will obviously lead to conflict between us and the potters'* (F4).

Specific statements were made in relation to the perceived impacts of the Atlantic Array development on the whelk fishery, *'They're going to destroy it'* (F5) and, *'That'll be the finish, the finish for whelking.'* (F6). The perceived end of the whelk fishery due to the Atlantic Array development is linked to the destruction of the habitat during the construction and the fact that the local fishermen are not convinced that they will be able to pot in the Atlantic Array following its construction due to the strong tidal current causing pots to drift into the restricted areas. The perceived impacts on lobsters, elasmobranchs and squid are also related to the construction and operation of the wind farm. One fisherman stated that there may be a future benefit of the Atlantic Array as an MPA by providing a refuge for fish.

Both the Atlantic Array and the rMCZs represent a potential loss of opportunity to local fishermen particularly for the mobile gear fishermen where

the location of catch can change from year to year and is not necessarily commensurate with the boundaries of the proposed rMCZs, *'It takes away the opportunity of...well, you'll never know what you are going to catch when you go to sea (F4) and, 'all and all, you could see the restrictions of what we got and we're pretty limited to what we can do' (F7)*. The loss of opportunity is also linked to restrictions on other fish species which historically used to be caught in the area e.g. spurdogs.

5.9 Strategies to adapting to change

The strategies that the respondents have suggested to adopt in order to adapt their fishing to fit the proposed regulations are listed below (Table 4) The modification of gear involves, *'We'd modify the trawls to work in rockier ground and things like that, which I don't know if that's the right way to go, really' (F4)*. The potters and trawlers who suggested diversifying fishing practices all made reference to taking advantage of scallop stocks. One fisherman has already made the change from trawler to scallop dredger

Table 4: A thematic framework of the potential strategies that the respondents will adopt to adapt to the proposed changes. Responses are shown as the number of fishermen who provided comments provided under each theme.

Themes for potential fishing strategies	Gear Type = Pots	Gear Type = Trawl
1. Modify gear	0	1
2. Open up new ground/move grounds	2	2
3. Diversify (change mode of fishing)	2	2
4. Use more gear to target crabs/lobster	3	0
5. Downsize boat (to under 15m)	0	1
6. Get a licence for welsh waters (whelks)	2	0

5.10 Respondents' suggestions for management.

The respondents' suggestions for the future management of the fisheries in the case study area are documented by the respondent's gear type in Table 5.

Table 5: A thematic framework of the respondents' suggestions for the future management of the fisheries in the North Devon Biosphere reserve area. Responses are shown as the number of fishermen who provided comments provided under each theme.

Themes for future management	Gear Type = Pots	Gear Type = Trawl
1. Compensation	3	0
2. Ban trawling in MCZs	2	0
3. Adaptive closures (seasonal, annual, rotation)	1	2
4. Exclude foreign vessels	0	2
5. Stop potters tying up ground with unused pots	0	1
6. Locally run fisheries (fishing co-operatives)	1	1
7. Decommissioning	0	1
8. Use local knowledge for monitoring programmes	0	1

Two suggestions involve compensation payments for the potential loss of the whelk fishery and a suggestion to finance the decommissioning of boats in order to allow some fishermen to exit the industry. The other suggestions involve the wider recognition that fishermen may be well placed to advise on conservation, *'Most fishermen I know will want to see and want to have a living next week and the week after that and next year and the years after that....'*(F5) and, *'I think if the fishermen were allowed to participate in a big way over conservation, instead of being dictated to, I think if the fishermen were in control of that, then there will always be a living to be had from the sea, and that would be a good living as well'* (F8). These management suggestions are locally focussed and include, the honouring local informal fishermen's agreements, *'There's nothing written down on paper; you might not speak to that person for months on end, but when you're at sea working gear, you'll put your hand up, you'll acknowledge people, and everybody just*

give each other a berth. No one crowd each other deliberately.....there's a sustainable living for everybody who's working at the moment' (F8); enabling fishermen to take part in discussions for adaptive closures, this includes allowing access to enable local fishermen to take advantage of opportunities using modified gear or long lines within the rMCZ, 'If you're going to cut off this here [the MCZ], then there's a lot of potential fish in that area that can't be harvested, and what a waste of resources. You know, someone, somewhere could find a way to longline' (F7); and involving local fishermen in monitoring the resource, 'Proper monitoring of it and, you know, not so big, not so vast. Let's concentrate on areas and, you know, try and get...I'm sorry to say it, and all these people and experts, they're not going to get more expert teams than the people who live on the ocean' (F4)

5.11 Trust

There was universal agreement from the respondents that there is a difference between what they are told by fishery scientists and managers and what they witness themselves when going about their fishing activity. The two suggestions for those who could potentially be the trusted source of information on any monitoring studies of the impacts of the MCZs were either the fishermen themselves or the local NDFA chief executive.

6 Discussion

This study has demonstrated that the marine environment in North Devon supports a small scale fishing industry where the majority of all the fishermen

are either indigenous to the area or have been fishing for the majority of their adult lives. Fishing is integral to their identity and well-being with both positive aspects (being outside, seeing nature, a sense of purpose, earning a living) and negative aspects (the stress of running a business and uncertainty over the future). These fishermen have previously adapted to change and their current fishing practices, choice of gear type and species caught are largely the result of adapting to European and national fisheries policy to take advantage of available markets.

There is a sense of satisfaction that the last year (2011) has provided good returns on fishing. The analysis of the economics of the fleet shows that all the vessels are profitable and this enables these fishermen to maintain an agreeable standard of living, employ crew members and support and/or employ some family members. There is an aspiration from these fishermen to be able to continue to earn a living and to be able to maintain its sustainability so there is an opportunity for the fishing business to be passed onto the next generation. The fishermen who were respondents to this study are mostly positive about conservation measures but the end result of the regional stakeholder process and the recent development of proposals for an Atlantic Array have added a large amount of uncertainty about the future. This has distanced these fishermen from the wider planning process.

Exactly how the implementation of the rMCZs and the development of the Atlantic Array would impact upon the fishing business and therefore the fishermen's welfare have been identified in this study as being driven by

displacement effects, gear conflict, increased pressure on grounds and stocks, impacts on current fisheries (particularly whelking), increased personal risk, increased costs, a loss of opportunity and unemployment. The strategies that these fishermen have stated that they may employ to be able to continue to make a living from fishing in this area include modifying gear, opening up new grounds, diversifying, increasing effort or moving to other areas to fish. The respondents' suggestions for how the change may be managed in the North Devon case study area include the receipt of financial aid either by compensation payments or decommissioning a part of the fleet. Other suggestions for management are focussed on operating with the MCZs in place. These include taking measures to ban trawling over sensitive marine features, excluding foreign vessels and managing the number of pots that are not in active use (tying up ground). Options suggested for working with the MCZ conservation guidelines include the establishment of locally run fisheries, adaptive closures and fishermen led monitoring programmes.

7 Recommendations

The success of MPA networks and sustainable fisheries depend on the continued involvement of stakeholders and aligning social with economic and ecological considerations (Banks & Skilleter 2010; Voyer et al. 2012). Both developing policy reforms and recent academic literature recognise that there is a need to align fisheries management with the management of MPAs (European Commission 2011; Gaines et al. 2010; Halpern et al. 2010; Urquhart et al. 2011). The recommendations from this study to facilitate future management of fisheries in-line with the conservation objectives include

undertaking measures to maintain profitability, foster certainty in the future and create opportunity for the North Devon fishermen to continue fishing.

7.1 Create common objectives (economic, social, ecological)

It has been known for an MPA to be both a 'biological success' in terms of fish abundance and improved habitat as well as a 'social failure' in terms of stakeholders not being involved in the management of the MPA, ineffective mechanisms for conflict resolution and the inequitable sharing of benefits between resource users (Christie 2004). The process of dialogue cannot end with the preliminary planning process (Voyer et al. 2012). Involvement and collaboration with stakeholders (particularly fishermen) is essential to the success of MPAs (Banks & Skilleter 2010). There is a need to maintain ongoing dialogue with stakeholders to address the perceived social impacts of the rMCZs and to create common objectives for the future management of the North Devon MPAs that align fisheries and conservation interests with the broader economic, ecological and social responsibility.

7.2 Trial co-managed fisheries in the MCZs

Standard economic theory demonstrates that if access to a resource is suddenly limited then this can in turn cause an overharvesting of a resource in the short-term. Recent studies of the response of commercial and charter fishers to the recent rezoning of the Great Barrier Reef Marine Park in Australia demonstrates that fishermen have maintained profitability by redistributing effort (Lédée et al. 2012). However, fisherman in this North Devon study have stated that space to fish is already limited and within this

study have suggested management strategies that could comprise part of a co-management arrangement e.g. adaptive closures. Therefore, a recommendation is made here to increase fishing opportunity by trialling a rights based, co-managed fishery in one or several of the rMCZs. Effective governance of MPAs has been shown to depend on institutional diversity where top-down and bottom-up management approaches are combined with economic incentives e.g. seeking higher prices for seafood harvested from a co-managed MPA (Jones et al. 2011; McCay & Jones 2011). The development of 'locally-based, tailor-made' fishing strategies could enable resource users to self-organise and develop conditions for continued co-operation for can help to overcome the temptations of short-term interest (Kraak 2011). The policy mechanisms by which a co-managed fishery could be established in this case study area would require further research.

7.3 Seek scientific/fishermen designed ecological monitoring programmes to set MCZ management plans and objectives.

This research has demonstrated that there is a lack of trust in the scientific advice that ultimately set the controls on how these North Devon fishermen undertake their activity, particularly when what they see out on the ocean is not reflected in the scientific advice given. Along with studies to document the socio-economic impacts of change (Christie et al. 2003; Symes & Hoefnagel 2010; Urquhart et al. 2011) there is a need to create a coherent connection between scientific expectation and fishers perceptions (Leleu et al. 2012) and between evidence based research and local knowledge (Jones 2009). Any long term monitoring programmes within the MCZs should involve fishermen

to improve the credibility of results (Heck et al. 2011). Exactly how the fishermen would like to be involved in the monitoring programme (e.g. data collection, programme design) would need to be determined. Results must be linked to the concept of evaluating the MPAs against the common objectives in order to inform adaptive management (Gaines et al. 2010).

8 Conclusion

It is known that society must find a way of aligning the limitations of the natural resource base with our demands on ocean resources (Tallis et al. 2012). The development of an ecological coherent network of MPAs, the reform of the Common Fisheries Policy, the onset of wider Marine Spatial Planning are part of this programme of change that will potentially yield localised social impacts that must be considered within an onward management framework. At present, the North Devon case study area supports a profitable fishing industry. The fishermen have identified where the potential impacts may be realised and what strategies they may adopt to maintain profitability. The fishermen have expressed support for conservation in-line with their fishing objectives. Therefore there is an opportunity to support a directional change that creates opportunity and certainty within the industry rather than forcing fishing activities to the margins. The possibility of aligned social, economic and environmental MPA objectives, co-managed MPAs and fisheries/scientific monitoring programmes could potentially provide a mechanism for the ecosystem based management of the marine resource base in this case study area.

9 Acknowledgements

This study would not have been possible without the support of the North Devon Fisherman's Association (NDFFA) or the North Devon Biosphere Reserve Service. We would like to thank John Butterwith (NDFFA) and Andy Bell (NDBRS) for their guidance. We would also like to thank Spike Searle (Marrok Marine) and Reece Woolgar for undertaking all the interviews necessary for this study. Finally we need to thank all the fishermen who gave up their time to take part and for offering us such an interesting insight into their lives in North Devon.

10 References

- Agardy, T., G. N. di Sciara, and P. Christie. 2011. Mind the gap: Addressing the shortcomings of marine protected areas through large scale marine spatial planning. *Marine Policy* **35**:226-232.
- Ashworth, J., and B. Stoker. 2010. Delivering the Marine Protected Area Network. Ecological Network Guidance to regional stakeholder groups on identifying Marine Conservation Zones. Page 124. Natural England and the Joint Nature Conservation Committee.
- Balanced Seas. 2011. Marine Conservation Zones Project. Final Recommendations. Page 78.
- Banks, S. A., and G. A. Skilleter. 2010. Implementing marine reserve networks: A comparison of approaches in New South Wales (Australia) and New Zealand. *Marine Policy* **34**:197-207.
- Brady, M., and S. Waldo. 2009. Fixing problems in fisheries—integrating ITQs, CBM and MPAs in management. *Marine Policy* **33**:258-263.
- Christie, P. 2004. Marine Protected Areas as Biological Successes and Social Failures in South East Asia. *American Fisheries Society Symposium* **42**:155-164.
- Christie, P., B. J. McCay, M. L. Miller, C. Lowe, A. T. White, R. Stoffle, D. L. Fluharty, L. T. McManus, R. Chuenpagdee, C. Pomeroy, D. O. Suman, B. G. Blount, D. Huppert, R. V. Eisma, E. G. Oracion, G. K. Lowry, and R. B. Pollnac. 2003. Toward Developing a Complete Understanding: A Social Science Research Agenda for Marine Protected Areas. *Fisheries* **28**. the
- Defra. 2002. Safeguarding our Seas - A Strategy for the Conservation and Sustainable Development of our Marine Environment, London.
- Degnbol, P., H. Gislason, S. Hanna, S. Jentoft, J. Raakjær Nielsen, S. Sverdrup-Jensen, and D. Clyde Wilson. 2006. Painting the floor with a

- hammer: Technical fixes in fisheries management. *Marine Policy* **30**:534-543.
- European Commission. 2011. Communication from the Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee of the Regions. Reform of the Common Fisheries Policy in T. E. Commission, editor. COM/2011/0417 final, Brussels.
- European Community Council Directive. 1992. Conservation of habitats and wild fauna and flora. Communities, editor. EC 92/43/EEC.
- Gaines, S. D., S. E. Lester, K. Grorud-Colvert, C. Costello, and R. Pollnac. 2010. Evolving science of marine reserves: New developments and emerging research frontiers. *Proceedings of the National Academy of Sciences* **107**:18251-18255.
- Halpern, B., S. Lester, and J. Kellner. 2009. Spillover from marine reserves and the replenishment of fished stocks. *Environmental Conservation* **36**:268-276.
- Halpern, B. S., S. E. Lester, and K. L. McLeod. 2010. Placing marine protected areas onto the ecosystem-based management seascape. *Proceedings of the National Academy of Sciences* **107**:18312-18317.
- Heck, N., P. Dearden, A. McDonald, and S. Carver. 2011. Stakeholder Opinions on the Assessment of MPA Effectiveness and Their Interests to Participate at Pacific Rim National Park Reserve, Canada. *Environmental Management* **47**:603-616.
- Hilborn, R., K. Stokes, J.-J. Maguire, T. Smith, L. W. Botsford, M. Mangel, J. Orensanz, A. Parma, J. Rice, J. Bell, K. L. Cochrane, S. Garcia, S. J. Hall, G. P. Kirkwood, K. Sainsbury, G. Stefansson, and C. Walters. 2004. When can marine reserves improve fisheries management? *Ocean & Coastal Management* **47**:197-205.
- Hiscock, K., and M. Breckels. 2007. Marine Biodiversity Hotspots in the UK. A report identifying and protecting areas for marine biodiversity. WWF UK.
- HM Government. 2009. Marine and Coastal Access Act. Page 347. Crown copyright.
- HM Government. 2011. UK Marine Policy Statement. Page 47. Crown copyright, London.
- Irish Sea Conservation Zones. 2011. Final recommendations for Marine Conservation Zones in the the Irish Sea. Page 53, Warrington.
- Jennings, S. 2009. The role of marine protected areas in environmental management. *ICES J. Mar. Sci.* **66**:16-21.
- Jentoft, S., B. J. McCay, and D. C. Wilson. 1998. Social theory and fisheries co-management. *Marine Policy* **22**:423-436.
- Jones, P. 2007. Point-of-View: Arguments for conventional fisheries management and against no-take marine protected areas: only half of the story? *Reviews in Fish Biology and Fisheries* **17**:31-43.
- Jones, P. J., W. Qui, and E. De Santo. 2011. Governing Marine Protected Areas - Getting the Balance Right. Technical Report. Page 105. United National Environment Programme, Nairobi.
- Jones, P. J. S. 2009. Equity, justice and power issues raised by no-take marine protected area proposals. *Marine Policy* **In Press, Corrected Proof**.

- Kelleher, G., editor. 1999. Guidelines for marine protected areas. World commission on protected areas. . IUCN. The World Conservation Union, Gland, Switzerland.
- Klein, C. J., A. Chan, L. Kircher, A. J. Cundiff, N. Gardner, Y. Hrovat, A. Scholz, B. E. Kendall, and S. Airama. 2008. Striking a Balance between Biodiversity Conservation and Socioeconomic Viability in the Design of Marine Protected Areas. *Conservation Biology* **00022**:691-701.
- Kraak, S. B. M. 2011. Exploring the 'public goods game' model to overcome the Tragedy of the Commons in fisheries management. *Fish and Fisheries* **12**:18-33.
- Lédée, E. J. I., S. G. Sutton, R. C. Tobin, and D. M. De Freitas. 2012. Responses and adaptation strategies of commercial and charter fishers to zoning changes in the Great Barrier Reef Marine Park. *Marine Policy* **36**:226-234.
- Leiberknecht, L. M., T. E. J. Hooper, T. M. Mullier, A. Murphy, M. Neilly, H. Carr, R. Haines, S. Lewin, and E. Hughes. 2011. Finding Sanctuary final report and recommendations. Page 101. A report submitted by the Finding Sanctuary stakeholder project to Defra, the Joint Nature Conservation Committee and Natural England.
- Leleu, K., F. Alban, D. Pelletier, E. Charbonnel, Y. Letourneur, and C. F. Boudouresque. 2012. Fishers' perceptions as indicators of the performance of Marine Protected Areas (MPAs). *Marine Policy* **36**:414-422.
- Lester, S., B. Halpern, K. Grorud-Colvert, J. Lubchenco, B. Ruttenberg, S. Gaines, and R. Warner. 2009. Biological effects within no-take marine reserves: a global synthesis. *Marine Ecology Progress Series* **384**:33-46.
- LiPuma, E. 1992. Social Identity and the European Community. *MAST* **5**:46-73.
- Marine (Scotland) Act 2010. Page 112, Crown Copyright.
- Mascia, M. B., C. A. Claus, and R. Naidoo. 2010. Impacts of Marine Protected Areas on Fishing Communities. *Conservation Biology* **24**:1424-1429.
- McCay, B. J., and P. J. S. Jones. 2011. Marine Protected Areas and the Governance of Marine Ecosystems and Fisheries. *Conservation Biology* **25**:1130-1133.
- Millennium Ecosystem Assessment. 2005. Ecosystems and human well-being: Synthesis. Page 155. The Millennium Ecosystem Assessment series. World Resources Institute, Washington, D.C.
- Net Gain. 2011. Final recommendations. Submission to Natural England and JNCC. Page 880, Hull.
- North Devon Biosphere Reserve Service. 2008. Our strategy for sustainable development 2008-2012. Page 26.
- North Devon Fisheries Local Action Group. 2011. North Devon FLAG Development Strategy 2011-2012. Page 8.
- OSPAR Convention. 2002. Convention for the protection of the marine environment of the North-East Atlantic in O. Commission, editor.
- Pollnac, R., P. Christie, J. Cinner, T. Dalton, T. Daw, G. Forrester, N. Graham, and T. McClanahan. 2010. Marine reserves as linked social-ecological systems. *Proc Natl Acad Sci U S A.* **107**:18262-18265.

- QSR International 2010. NVivo qualitative data analysis software.
- Rees, S. E., M. J. Attrill, M. C. Austen, S. C. Mangi, J. P. Richards, and L. D. Rodwell. 2010. Is there a win-win scenario for marine nature conservation? A case study of Lyme Bay, England. *Ocean & Coastal Management* **53**:135-145.
- Roberts, C. M., J. A. Bohnsack, F. Gell, J. P. Hawkins, and R. Goodridge. 2001. Effects of Marine Reserves on Adjacent Fisheries. *Science* **294**:1920-1923.
- Rosendo, S., K. Brown, A. Joubert, N. Jiddawi, and M. Mechisso. 2011. A clash of values and approaches: A case study of marine protected area planning in Mozambique. *Ocean & Coastal Management* **54**:55-65.
- Salas, S., and D. Gaertner. 2004. The behavioural dynamics of fishers: management implications. *Fish and Fisheries* **5**:153-167.
- Secretariat of the Convention on Biological Diversity. 2004. Technical Advice on the Establishment and Management of a National System of Marine and Coastal Protected Areas. Page 40 in SCBD, editor. CBD Technical Series number 13.
- Sobel, J., and C. Dahlgren 2004. *Marine Reserves. A Guide to Science, Design and Use*. Island Press, Washington.
- Symes, D., and E. Hoefnagel. 2010. Fisheries policy, research and the social sciences in Europe: Challenges for the 21st century. *Marine Policy* **34**:268-275.
- Tallis, H., S. E. Lester, M. Ruckelshaus, M. Plummer, K. McLeod, A. Guerry, S. Andelman, M. R. Caldwell, M. Conte, S. Copps, D. Fox, R. Fujita, S. D. Gaines, G. Gelfenbaum, B. Gold, P. Kareiva, C.-k. Kim, K. Lee, M. Papenfus, S. Redman, B. Silliman, L. Wainger, and C. White. 2012. New metrics for managing and sustaining the ocean's bounty. *Marine Policy* **36**:303-306.
- Urquhart, J., T. Acott, M. Reed, and P. Courtney. 2011. Setting an agenda for social science research in fisheries policy in Northern Europe. *Fisheries Research* **108**:240-247.
- Videras, J., A. L. Owen, E. Conover, and S. Wu. 2012. The influence of social relationships on pro-environment behaviors. *Journal of Environmental Economics and Management* **63**:35-50.
- Voyer, M., W. Gladstone, and H. Goodall. 2012. Methods of social assessment in Marine Protected Area planning: Is public participation enough? *Marine Policy* **36**:432-439.