European MSP Platform

Conflict Fiche 9: Commercial fisheries and area-based marine conservation

Commercially exploited fish and shellfish are all living marine resources targeted for economic profit. The most common resources include bony fish, sharks and rays, crustaceans such as lobsters and shrimps, as well as molluscs (including bivalves, cuttlefish and squid)[1]. Commercial fisheries can come into conflict with area-based marine conservation, e.g. when measures are taken that reduce the area available for fishing or when certain fishing practices reduce the benefits of area-based conservation. This fiche sets out what can be done to mitigate such conflicts.

1. Description of the two sectors

1.1. Commercial fisheries

Fishing traditions go back hundreds of years, and historically, fishers were not bound by administrative borders. This still applies to some degree, so for example, many Dutch vessels fish in UK waters and vice versa, although restrictions do apply with respect to territorial waters.

Commercial fisheries represent an important economic sector for coastal regions and communities in many EU countries[2]. Gross profit and net profit margins have improved over recent years, possibly due to healthier stocks[3] and aided by more efficient vessels and fishing methods. More industrial methods are becoming common in the entire value chain, and new techniques are constantly being introduced to increase the overall catch while decreasing bycatch.

Commercial fishing is really a form of hunting. Although the exact patterns depend on the type of fish, fishers mostly look for shoals which move between different food-rich areas. Fishing vessels therefore move in unpredictable ways and unlike other vessels making use of shipping lanes. Fishers also need to make sure they use their time fishing efficiently as fuel and time is expensive. Costs are a major issue for fishers, especially small-scale coastal fishers whose profit margins have shrunk considerably in the wake of regulation and decreasing stocks.

The most common fishing method is bottom trawling, which is used to catch the majority of commercial species such as cod, haddock, plaice, sole and whiting. Different intensities of bottom trawling occur in different sea areas (Figure 1). Fixed gear, including permanent fish traps in coastal areas and bottom and midwater gill nets, is usually anchored to the ground and can be

[1] European Commission (2018a)
[2] Altvater et al. (2018)
[3] European Commission (2018b)

permanently installed or during certain periods of the year. Nets can occupy several square kilometers.

Capture fisheries have different direct and indirect impacts on the marine environment and ecosystems. The most obvious is the removal of biomass, which has impacts on the community structure of species or the genetic composition of populations[4]. Conflicts with marine conservation also arise over certain fishing practices (such as bottom trawling) that can have impacts on habitats and organisms other than the target species.

Although some stocks in the EU are still overfished, preserving healthy stocks is a key concern of fisheries managers and fishers themselves. Preserving spawning and nursery areas is also likely to be of increasing importance in the face of climate change. Fisheries conservation measures can include fisheries conservation areas, where it is the fisheries managers themselves that close certain areas for conservation reasons.

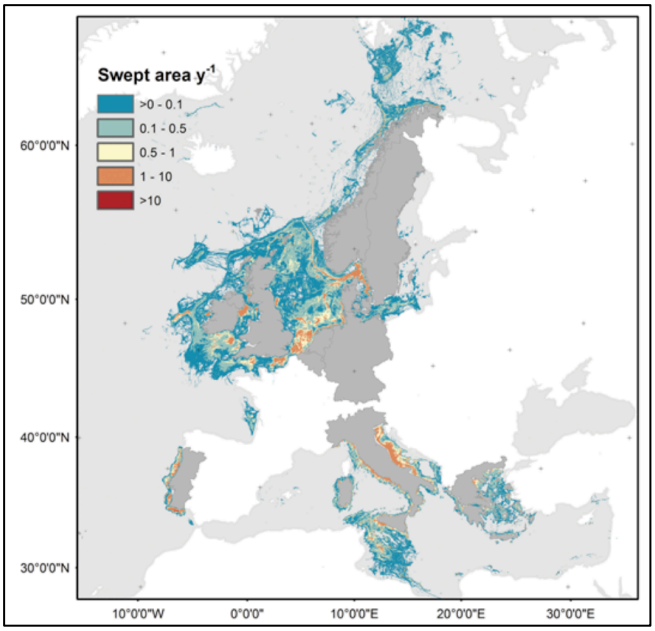

Figure 1: Bottom Trawling Intensity[5]

1.2. Area-based marine conservation

Marine conservation generally is a huge field of research and policy. Operating at the international, national and sub-national level, it can be broadly differentiated into area-based approaches, as well as approaches that target overall ecosystem health or particular species, such as efforts to reduce pollution or bird protection.

The main tool for area-based marine conservation is Marine Protected Areas (MPAs), but there are other designations that fulfil the same function (such as Natura 2000 areas). There has been a tenfold increase in MPA designations around the world since 2000[6] [7]. At the same time, MPA

[4] Jennings & Kaiser (1998)
[5] Eigaard et al. (2017)
[6] IUCN (2017)

designation alone does not necessarily mean successful conservation[8]: Large but wrongly located and managed MPAs may potentially achieve fewer conservation outcomes than a smaller but correctly placed and managed MPAs.

MPAs protect biodiversity and marine ecosystems. They can be established within national borders, as part of transboundary agreements, or in international waters such as in Areas Beyond National Jurisdiction (ABNJ), although enforcing rules in international waters is difficult [9]. Apart from conservation benefits, MPAs can also have economic benefits, e.g. for recreation and fisheries.

Impacts caused by fishing can reduce the conservation benefits of area-based approaches to marine conservation[10]. Even when total bans on certain activities are in place within MPA boundaries, habitats and species are still affected by pressures originating outside of the protected area. This is most obvious in the case of water or noise pollution[11], but extractive practices such as fishing reduces the available biomass and therefore also have impacts.

For marine conservation to be effective, it is important that its design and management includes a wide range of stakeholders – including all the sectors that will be affected by, or will themselves affect, protected areas or species[12]. Fisheries and marine conservation are in fact closely interrelated: a thriving fishery industry requires healthy stocks, while marine conservation can benefit from sustainable fishing practices and the environmental knowledge of fishers.

2. Conflict description

2.1. Conflicting elements

One of the most important prerequisites for sustainable fisheries is access to reliable fishing grounds, especially for small-scale fisheries near the coast. From the perspective of commercial fisheries, the main source of conflict tends to be spatial exclusion (such as the imposition of no-take zones or areas with limited access to fishery), although conflicts can also arise from a more general lack of integration between fisheries management and conservation[13]. From the perspective of area-based conservation, the need to conserve fish stocks in line with MSFD objectives and fishing practices outside MPAs can be a conflicting element. Specific dimensions of conflict related to area-based conservation are listed below.

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[7] https://www.cbd.int/sp/targets/, accessed 3 January 2019
[8] Amengual & Alvarez-Berastegui (2018)
[9] Hossain & Morris (2017)
[10] Coomber et al. (2016)
[11] Blau & Green (2015)
[12] Dehens & Fanning, (2018)
[13] Jones et al. (2016)

- *Spatial exclusion*

Spatial measures (e.g. no-take zones in Marine Protected Areas) proposed by the authorities can be a strong source of conflict. Fishers often object to such proposals, given that they might imply relocating to less productive fishing grounds, further from the fishing port, or changes of fishing gear, all implying additional costs. In EU Member States with small sea spaces spatial measures may imply the total loss of fishing areas rather than merely relocation.

- *Destructive fishing practices, including bycatch and litter*

Most fishing practices, such as some techniques of bottom trawling which harvest the target fishing resources, have impact on non-target species and therefore on the broader ecosystem (incl. sea bottom morphology, sediments structure, biochemical balance). Litter produced by fishing practices can also have considerable impacts, especially in the case of lost gear, leading to ghost fishing.

- *Synergies*

Positive effects of sound conservation for the fish stocks and the fisheries sector can be evident in cases where appropriate management tools, technical measures, and fishing capacity control are implemented. Although their usefulness and exact benefits for fisheries continue to be debated, there is evidence that fish stock recovery areas or no-take areas can aid the recovery of commercially important species[14]. Benefit to nearby fisheries through spill-over and export of offspring from protected stock has also been recorded. No-take areas can also help set positive management precedents.

2.2. Spatial Context

Given that fishing often takes place across the exclusive economic zones of several states, conflicts can also take place across several states. Although fisheries management is harmonized across the EU according to CFP rules, different countries still take individual approaches, which can make coordination difficult. Countries also have different ways of dealing with conflicts between fisheries and area-based marine conservation, ranging from spatial and temporal closures and restrictions to managing bycatch and restricting certain high impact fishing techniques. Access arrangements and relevant allocation rules are usually based on different criteria, leading to location-specific rules as to who may fish or how, when or where. Rights of access may be granted based on historical connections to fishing grounds[15], but other social and environmental considerations including spatial prerequisites usually also come into play.

[14] Dahlgren & Tewfik (2015)
[15] Grieve, C. (2009)

3. Drivers of conflict

Within the EU, the conservation measures put into place are expected to result in stock rebuilding and increasing profitability of fisheries in the long term. Nevertheless, economic pressure on fishers is still strong, e.g. as a result of rising fuel costs. Restricting fishing areas is likely to increase pressure especially on smaller operations working closer to the coast. In addition, the occurrence and distribution of fish stocks may change in response to climate change, requiring fishers to respond flexibly.

International environmental policy sets out ambitious targets. The Aichi targets for the Convention on Biological Diversity stipulate that by 2020, 10% of marine areas, especially those of high biological and ecological significance, should be managed as protected areas. Other political drivers include the UN Sustainable Development Goals, especially Goal 14 "Life under water", as well as EU-wide and national biodiversity and climate polices. In its Marine Strategy Framework Directive the EU expects Member States to reach "good environmental status" of marine waters by 2020. Descriptor 3 on commercial fish and shellfish states that "populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock." This means stocks should be, (1) exploited sustainably consistent with high long-term yields, (2) have full reproductive capacity in order to maintain stock biomass, and (3) the proportion of older and larger fish/shellfish should be maintained (or increased) being an indicator of a healthy stock[16]. Other MSFD descriptors also come into play, such as biodiversity (e.g. overfishing, bycatch) and sea floor integrity (affected e.g. by bottom trawling). Increasingly, there is also public opinion on healthy seas, in particular on achieving sustainable fisheries and protecting iconic species such as seabirds and mammals.

A more fundamental question is how to make trade-offs between marine conservation and fisheries. One option is to explore synergies and use fisher's knowledge to help conservation efforts and vice versa. Another option is to pursue the development of standardised surveys and programmed data collection to estimate conservation measures that are forecast to reduce environmental impacts and increase fisheries yields. Yet another development may be the increasing diversification of fishers into areas such as recreational fishing and tourism, which also depend on good marine conservation status of charismatic megafauna (e.g. dolphin watching).

Story 1: A long road to a Fisheries Restricted Area: The Jabuka Pomo Pit (Italy – Croatia – Slovenia)

For many years, national and supranational authorities, research institutes and NGOs have attempted to protect a valuable marine habitat in the Central Adriatic named Jabuka/Pomo Pit. Strong opposition from fishing associations and continuous fishing regardless of spatial management measures were major causes of conflict. Scientists from the FAO AdriaMed Project had long called for wider protection of the Jabuka/Pomo Pit[17], and a range of local and international

[16] European Commission (2016)
[17] MedReAct (2017)

organisations, administrations, individuals and NGOs were extensively involved in this process. This conflict is not directly dealt with through MSP, but rather through research advice, management of fishing resources, and stock assessment. However, new initiatives and projects have emerged in recent years that are using more spatial data in their analysis and providing advice to management and spatial planning efforts.

Due to its natural characteristics, the Jabuka/Pomo Pit area has been recognised as a critical habitat for demersal species, in particular, for hake and Norway lobster. However, these species have commercial value and are subject to persistent overfishing. The negative trends in demersal stock biomass over the past 20 years show that the resource is exploited at unsustainable levels.

Scientific advice, initiatives and temporal closures have taken place in the Jabuka /Promo pit since 1992, including the Croatian declaration in 2003 of an Ecological and Fishery Protection Zone (ZERP). Greenpeace's proposal in 2004 for setting up a network of marine reserves in the Mediterranean also included the Jabuka/Pomo Pit [18] [19].

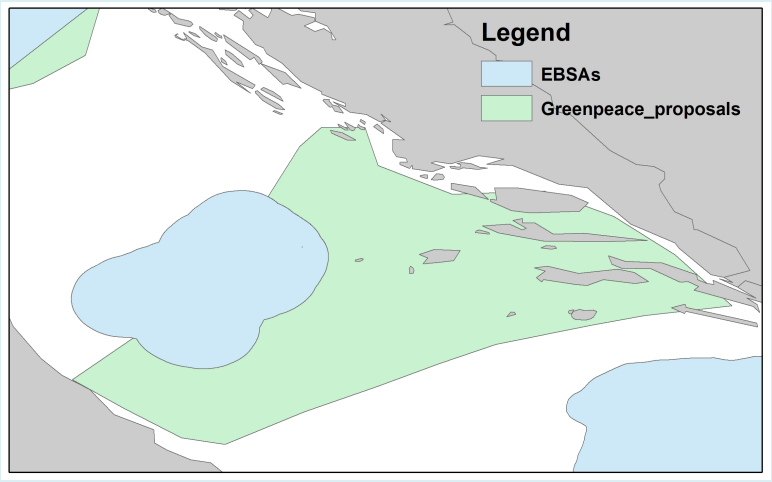

Figure 1: Map visualising the Greenpeace proposals created through GIS during the completion of the present note[20]

The AdriaMed project (2010) found that the exploitation pattern of hake and Norway lobster was far from optimal, given the un-selectivity of bottom trawl nets catching large amounts of juveniles and undersized hake, even when utilising the regulated larger mesh size.

Long-term spatial management options were explored based on the fact that

- hake is a long-lived species, and short-term fishing closures cannot be expected to produce substantial effects;
- Norway lobster is a relatively long-lived species which, during the first year of its life, remains hidden in burrows and cannot be taken by trawlers.

[18] Greenpeace (n.n.)
[19] UNEP (2010)
[20] Layer sources: for EBSAs layer - MAPAMED, the database on Sites of interest for the conservation of marine environment in the Mediterranean Sea. MedPAN, UNEP/MAP/RAC-SPA. May 2016 release; for Greenpeace_proposals layer: Greenpeace's proposal for a network of marine reserves in the Mediterranean, 2008.

Scientists recommended an experimental three-year closure, to be reviewed on the basis of results from annual monitoring. Several area sizes were presented as possible options to protect a larger or smaller portion of the nursery grounds.

In 2011, the prohibition on trawling in the Zones of Biological Protection (ZTB)[21] was reconfirmed in the Italian Management Plan for Demersal Fisheries in the Adriatic. However, despite these repeated rulings, fishing continued unabated. The following maps indicate constant fishing activities in the ZTB (small black square marked on the maps) by the Italian fishing fleet in the years 2012-2014.

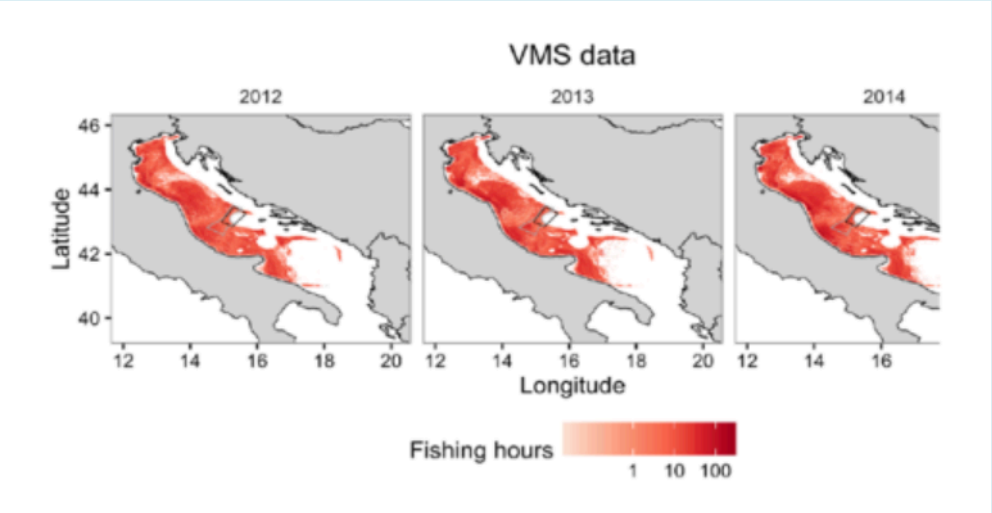

Figure 2: VMS data showing continuous undisturbed fishing in the area[22]

In 2016 the fortieth session of the General Fisheries Commission for the Mediterranean (GFCM) discussed the possible adoption of encounter protocols for Vulnerable Marine Ecosystems (VMEs). This was to ensure the collection of necessary data on the distribution of such ecosystems, with a view to identifying priority areas (extension of the assessment of alternative management measures to demersal stocks, especially European hake) for the future establishment of spatial protection measures. These included options to increase the minimum conservation reference size and impose spatial-temporal closures or establish a Fisheries Restricted Area FRAs.[23]

There were also extensive national efforts to monitor and ban fishing from the area. Figure 3 shows "Scalata del Fondaletto", an area corresponding to the north-eastern slope of the Jabuka/Pomo Pit where a series of temporal bans and monitoring rules were introduced for Italian fishing vessels in the Jabuka/Pomo Pit[24] [25].

[21] In 1998, under Italian law (D.M. 16 June 1998), the Jabuka/Pomo Pit was declared a Zone of Biological Protection (Zona di Tutela Biologica – ZTB) and professional and recreational fisheries were banned from an area of 2,226 km² of the Jabuka/Pomo Pit. More information available at http://gazzette.comune.jesi.an.it/156/10.htm

[22] MedReAct (2017)

[23] GFCM (2016)

[24] Federcoopesca (2017)

[25] Politiche Agricole (2016)

Punto	Lat (WGS84)	Lon (WGS84)
1	43° 32' 03'' N	015° 16' 30'' E
2	43° 05' 27'' N	014° 58' 39'' E
3	42° 49' 49'' N	014° 29' 33'' E
4	42° 47' 38'' N	014° 34' 19'' E
5	43° 02' 50'' N	015° 02' 14'' E
6	43° 29' 52'' N	015° 20' 42'' E

Figure 3: The area with red boundaries represent the Scalata del Fondaletto in which fishing activities were banned in 2016. In the table coordinates are reported for the points corresponding to the vertex of the Scalata del Fondaletto protected area[26]

Based on the work of MedReAct and the Adriatic Recovery Project[27], the Subregional Committee for the Adriatic Sea (SRC-AS) examined the contents of the proposal to establish a Fisheries Restricted Area (FRA) and agreed to present it to the Scientific Advisory Committee (SAC) of the General Fisheries Commission for the Mediterranean (GFCM) for its final validation and potential submission to the GFCM. Finally, with the help of many international bodies, universities and research institutes, a proposal was submitted on behalf of the Adriatic Recovery Project.

Pressure on the European Commission to permanently protect the Jabuka/Pomo Pit was exerted by more than 20 NGOs[28]. As a result, at the EU-hosted Our Ocean conference in Malta (October 2017), one of the commitments of the EU was to support the General Fisheries Commission for the Mediterranean in establishing a Fishing Restricted Area (FRA) of at least 2,700 km² in the Jabuka/Pomo Pit.[29] Moreover, over 200 scientists from universities and research institutes around the world signed an appeal to ask GFCM for the protection of the Jabuka/Pomo Pit.[30]

[26] Minstero della politiche agricole alimentary e forestali (2018)
[27] The Adriatic Recovery Project is an international alliance of environmental organizations and research institutions created to preserve the vulnerable marine ecosystems and essential fish habitats of the Adriatic Sea.
[28] MedReAct (2017a)
[29] OurOcean (2017)
[30] MedReAct (2017b)

On 17 October 2017 GFCM adopted the EU proposal for the establishment of a Fisheries Restricted Area in the Jabuka/Pomo Pit banning demersal fisheries. This proposal divides the FRA in 3 areas:

Zone A for which any recreational and professional fishing activity with bottom-set nets, bottom trawls, set longlines and traps is prohibited;

Zone B where fishing activities with bottom-set nets, bottom trawls, set longlines and traps is prohibited from 1 September to 31 October each year and starting from 2017 and allowed (for a maximum of one-two fishing days per week depending from gears) the rest of the year, provided that the vessel and/or its master is in possession of a specific authorization and that historical fishing activities in zone B are demonstrated;

Zone C where fishing activities with bottom-set nets, bottom trawls, set longlines and traps and recreational fisheries are prohibited from 1 September to 31 October each year (starting from 2017) and allowed if the vessel or its master is in possession of a specific authorization and if historical fishing activities in zone C are demonstrated. In zone C bottom trawls shall be entitled to fish only on specific days and hours.[31]

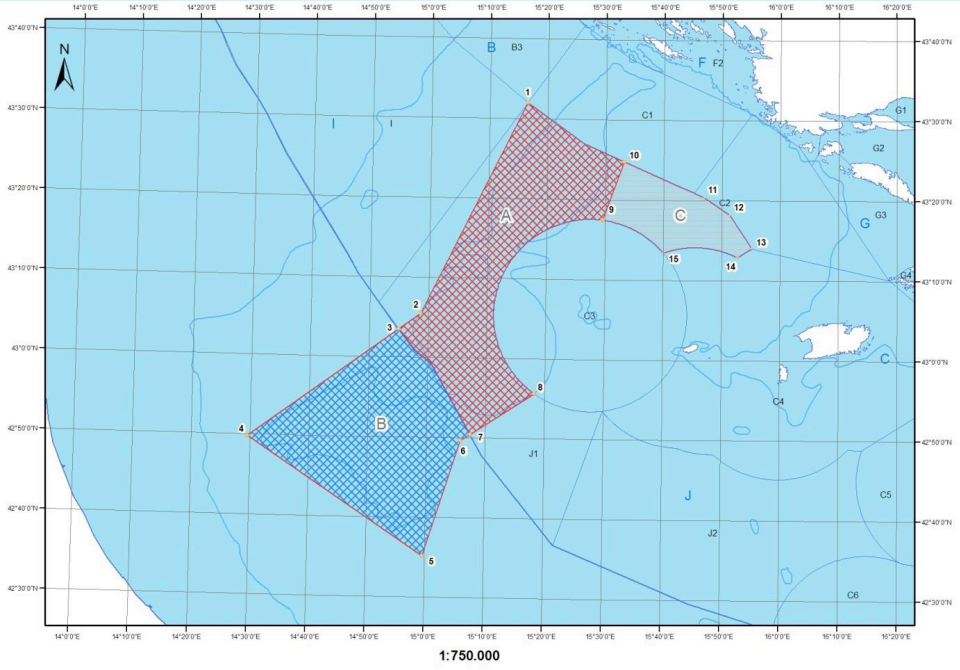

Figure 4: Spatial subdivision of the Jabuka/Pomo Pit FRA between the three areas (A, B, C) each with different types of restrictions based on GFCM Recommendation[32].

[31] FAO (2018)
[32] GFCM (2017)

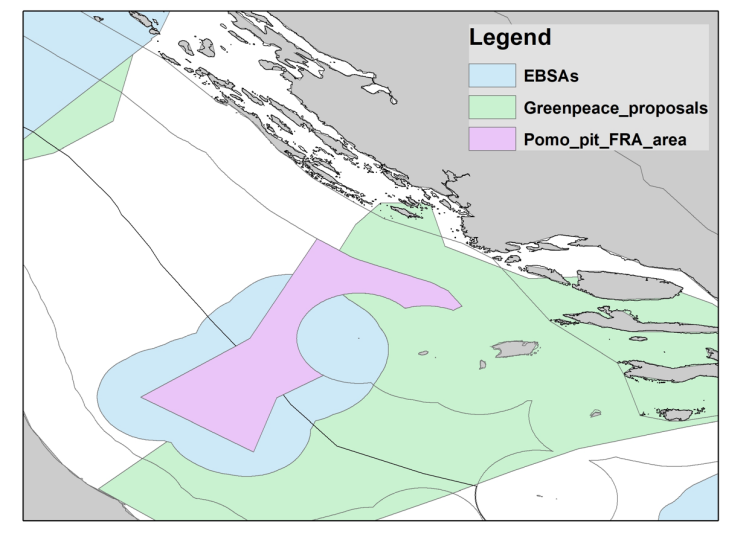

Figure 5: Overlap of the EBSAs, Greenpeace proposals and FRA area[33]

The published Regulation of the European Parliament and of the Council of amending Regulation (EU) No. 1343/2011 on certain provisions for fishing in the GFCM Agreement area includes specific information on the provisions that should be implemented in the Jabuka/Pomo Pit FRA based on the Recommendation GFCM/41/2017/3 on the establishment of an FRA in the Jabuka/Pomo Pit in the Adriatic Sea.[34] The Jabuka/Pomo Pit FRA is expected to come into force under EU regulation in 2018.[35]

Fishers can fish across multiple countries, while fishing in one country can also have impacts on the fish distribution in another country. As shown by this story, the conflict between fisheries and environmental protection often has a transnational dimension, meaning it is governed by international/sea basin frameworks. Moreover, as shown in this example, the utilisation of spatial planning and scientific research advises might not be sufficient to resolve a conflict such as this one. Active involvement of not only national, but also international institutions, NGOs, policy makers and scientists is crucial to ensure that the proposed spatial measures are implemented and enforced.

Story 2: Negative interactions between dolphins and fishing in Corsica (France)

Bottlenose dolphins (*Tursiops truncatus*) have a very large distribution range and are found all around Europe. They exploit a large variety of coastal habitats up to 200 meters in depth and are generally encountered in groups of about ten, rarely more than 20. Bottlenose dolphins like interface zones between two marine environments, which are zones with greater diversity and abundance of fish. This puts them into direct competition with fishers, especially in Corsica where the coastal strip is particularly narrow. In 2000, within the context of its «Cap Ligures» programme for the conservation of Mediterranean marine mammals, WWF-France did an inventory of

[33] Produced by Thetis (2018) for the purpose of this fiche.
[34] European Commission (2018c)
[35] European Commission (2017)

bottlenose dolphins in Corsica. They found dolphin communities all around the island but fewer on the eastern side. They also encountered the anger of fishers, which had reached a critical point in the face of increased attacks by bottlenose dolphins on their nets.

In this particular case, the dolphins had learned to take advantage of fishing nets for their own benefit. They sometimes eat directly from them, tearing the nets and angering the fishers as nets are difficult or even impossible to repair. Aggression towards dolphins and accidental captures were the consequences.

At the same time, the bottlenose dolphin plays an essential part in the marine ecosystem as a major predator. Disturbing its biology could cause an imbalance in ecosystem functioning, potentially directly impacting the fishing industry.

The international marine sanctuary PELAGOS (comprising Bonifacio and Scandola and the Agriates) holds half of the total Corsican bottlenose population, estimated at between 198 to 242 individuals. The conflict is also due to overfishing and the reduction of fish stocks, leading to the accentuation of competition between dolphins and fishers.

The EU-funded LINDA[36] project helped to quantify the extent of the conflict between the dolphins and the fishers. It determined the impact of the attacks on fishing and suggested alternative practices which may limit them. It studied 1075 nets during 386 sea trips in 2004, involving 27 fishing boats of which 13% had been attacked by dolphins. The project revealed that fishing nets were attacked by dolphins every 4 or 5 fishing days. Certain variables were found to influence the frequency of attacks: high production nets, small mesh sizes (mesh > 9, 9 is the number of knots per 25 cm), and nets set between 25 and 50 metres deep. Analysis showed an interesting fact, namely that the commercially valuable species targeted by fishers are not part of the bottlenose dolphins' usual diet.

The LINDA project worked on implementing measures to reduce the conflict: working with fishers to devise strategies for avoiding bottlenose dolphins, testing alternative fishing techniques, producing economic assessments of the cost of modifying fishing techniques etc. As a result, the relationship between fishers and dolphins has improved over time. The involvement of fishers, regular information on the progress of results, consideration of their suggestions and finally, the attention paid to the difficulties faced by their profession, largely contributed to calm the tensions which were palpable at the start of the study.

As shown in this example, the conflict between fishers and environmental protection has many faces, and the implementation of spatial measures, zonation systems or a fishery ban is not always the right solution. While many countries do not deal with this conflict as part of the MSP process, this example shows that a more integrated approach to management and decision making is crucial in order to consider the perspectives of multiple sectors. Active engagement with fishers and improved awareness of the importance of safeguarding a balanced ecosystem is also important.

[36] More information about the LINDA project is available at: http://www.lifelinda.org/telechargement/

Story 3: Trawling in the Koster-Väderö fjord (Sweden)

The Koster-Väderö fjord is located off Sweden's northwest coast, in a corner of the Skagerrak Strait dividing Sweden and Norway from Denmark. The fjord is home to Sweden's highest diversity of marine life: between 5,000-6,000 species are thought to be found there, including 200 animal species and nine algae species unique to the area. After years of conflict, negotiation and collaboration between authorities and stakeholders, including members of local fishing communities, resulted in the area becoming the first marine National Park, called 'Kosterhavets', declared under Swedish law in September 2009.

There were several proposals on marine protected areas, put forward by the authorities and nature conservation groups. In the beginning, strong conflicts with fishers were encountered, including demonstrations and arguments in media. The local fishery occupies around 50 fishers in 30 boats (10 – 26 meter). Their main fear was that they would be excluded from their fishing areas. A participatory process was initiated by the provincial government, and eventually an agreement was reached between fishers, their organisations, the fishery authority, the provincial government and the local communities. A co-management project was initiated and developed from 2005-2008.

The long participatory process was crucial for the resolution of this conflict[37]. Comprehensive stakeholder identification was important, as was the fact that overall principles were agreed by the authorities. Terms such as MPA, reserves and sustainable fishery were defined in a shared process, and fishery legislation was used rather than conservation legislation. A steering group was set up and goals agreed upon, as well as methods and roles. An inventory phase, was followed by a dialogue and negotiation, and finally an agreement phase. The last and ongoing phases are follow up, including education and initiating a fishery and co-management initiative.

Story 4: What options for regulating fishing activities?

The Adlergrund area in the German Baltic Sea is a designated Natura 2000 area (SAC, SPA). The main nature conservation values are wintering sea ducks; harbour porpoise and seals also occur in the area. Both birds and dolphins are implicated by gill net fishery. In the context of debating possible management measures, the question has been raised what legislation could be used as a basis for ensuring the protection of birds and dolphins[38].

The Habitats Directive demands the designation of special protection areas for harbour porpoise, in particular genetically isolated and very rare variants (such as the eastern Baltic harbour porpoise). In such cases, Member States are obliged to take adequate measures to eliminate dangers, as set out in the Habitats Directive. Action can therefore be taken by the Member States to restrict fisheries if this is necessary for achieving protection objectives. The need for the restriction has to be described and explained in the management plan of the site, explaining why there are no

[37] See https://www.fishsec.org/app/uploads/2011/03/1244228315_50491.pdf
[38] Schmiedel & Winter (2012)

alternative means of reaching the protection objectives. The restriction would then be imposed as part of a protection scheme according to national nature conservation legislation. In an area that is not covered by the Habitats Directive, national nature conservation legislation can still make some management provisions. However, without the overriding guidance of the Habitats Directive, introducing restrictions such as a ban on gill nets is a different process. According to the EC[39], countries "may take measures for the conservation and management of stocks in waters under their sovereignty or jurisdiction". This, however, would require the government to apply to the European Commission, with a view to seeking adoption for the proposed measures by the European Council and Parliament. Spatial and/or seasonal restrictions to the use of certain gears would then be enshrined an EU regulation, with immediate effect for fishing vessels flying EU Member States' flags.

Aspect / Story	Story 1: Italy, Slovenia, Croatia	Story 2: France	Story 3: Sweden
Main causes of conflict	Strong opposition from fishing associations and continuous fishing regardless of spatial management measures	Dolphins attacks to the fishing nets and loss of earnings of fishers due to lost catch and lost nets	Spatial overlap between valuable fishing grounds and proposed protection zone
Role of stakeholders	A wide range of actors have advocated for the closure, including the international bodies, NGOs, scientists	It was important to closely engage with fishers to understand the extent of the conflict ad jointly work on the technical solutions	Extensive engagement of all parties involved and eventual agreement about the co-management process
Escalating factors	None	Aggression of fisherman towards dolphins possibly affecting the balance of the overall ecosystem	Arguments in the media and demonstration of fishers
Solution(s) found	Translational agreement through the GFCM and the EU, and the designation of the closure.	Multiple technical solutions including a different net mesh size, building awareness of fisherman about the importance of the dolphin for the balance of the ecosystem	Co-management was initiated which included multiple projects to ensure fishery management in the protection zone
Solution accepted by stakeholders	Unclear – additional studies would have to confirm if the closure has been appropriately implemented and enforced. Monitoring of the area can provide information about presence of illegal fishing.	yes	yes

[39] European Council (2002)

4. Solutions

4.1. Prevention

Solution 1: In transboundary cases, encourage coherence through shared understanding of terminology and technical requirements for implementing policy

In conflicts that have transboundary character, it is important for countries to agree on the harmonization of regulations. In reaching a joint solution, it is also important to come to a shared understanding of terminology and traditional practices. Careful planning of, and carrying out transnational consultations as set out in the EU MSP Directive can play an important role. In order to ensure a more harmonised approach, it is important to consider transnational consultation early in the MSP process, especially given the fact that Member States have different national fishery management mechanisms in place and use different tools for implementing these. While MSP-based consultation does not directly solve the conflict, it is one of the pre-requirements for the implementation of spatial planning or other techniques, and can to a certain extent prevent conflicts from occurring in the first place.

In the Jabuka/Pomo Pit conflict example, five technical discussions on the technical and monitoring measures for fisheries took place in 2007 between Slovenia, Croatia, Italy and the EU Commission. These led to an agreement on fisheries protection in the Jabuka/Pomo Pit. However, this protected area was to be partly in the Croatian ZERP and partly in international waters (on the Italian side of the continental shelf national limit). The two countries (Slovenia and Italy) played an active part in the technical discussions with Croatia on the comparison of the technical rules in the Adriatic and on the protection of vulnerable fishing grounds in the Jabuka/Pomo Pit area in accordance with the Common Fishery Policy *acquis*. These did not directly solve the conflict but rather made a suitable ground for further discussions and acted as a prerequisite for future agreements.

4.2. Mitigation

Solution 2: Use more dynamic spatial planning when closing areas to fishery

Spatial management approaches in fisheries tend to be linked to static boundaries and coarse temporal scales, although the dynamic of interactions between fish and their environments has long been recognized. Dynamic assessment of the impacts of temporal fishery closures through dynamic data collection and analysis can contribute to more informed planning and more optimal solutions. Instead of only considering the traditional static bans, such tools can enable planners to take a more dynamic approach, where the size and temporal dimension of a closure can be revised for each new version of the maritime spatial plan.

For example, for studying the Jabuka Pomo Pit, Stanford scientists used a tool called EcoCast[40] that is based on satellite data, maps, and observations that can be used to locate the most productive fishing grounds. The software combines the most recent satellite data of ocean conditions, records

[40] Hazen. L. E. (2018)

from fisheries observers and species tracking data to pinpoint ideal fishing areas on a daily basis. For tracking fishery movement, it uses a common onboard technology, Automatic Identification System (AIS), that regularly transmits data as a way of preventing collisions. Tracking fish distribution can also contribute to reduced catch of unwanted or protected species. The tool could be used:

- To observe fishing behaviour around other marine protected areas and to track whether the bans force fishers into other sensitive ecosystems;
- by fishers to improve their harvest of target fish and avoid unwanted or protected species such as sea turtles and dolphins;
- as a deterrent to violating fishing restrictions.

In the Jabuka Pomo example, scientists specifically tracked vessels during a short-lived trawling moratorium in the Adriatic Sea and found that fishing vessels who complied with a one-year fishing ban maintained their catch levels by moving to other areas. This finding also contributed to the resolution of the conflict in the Jabuka Pomo Pit. The study also holds promise for other highly exploited areas around the world where enforcement is challenging.

Apart from AIS, that tracks the movement of fishing vessels, monitoring of species distribution (for example monitoring of Norway lobster stocks) can be done by

- TV survey with camera towed on the bottom of the sea which record a standardized length of sea bottom which is used to count the number of the holes/shelters made by Nephrops norvegicus (In the Adriatic Sea the survey is conducted every spring).
- Trawling survey with the research vessel (catching the lobster) (In the Adriatic Sea such survey done every winter). In general, there are two types of surveys 1) camera and trawling, or 2) only trawling.

Solution 3: Consider the tradition of fishing and the position of ports when determining closures for different types of fishery

When deciding on the area where a fishing ban is to be implemented, planners have often considered:

- The tradition of fishing in order to ensure that heritage can be preserved, and
- The position of ports, both as an indicator of traditional fishers and as part of fisheries heritage more generally. The proximity of the port to a fishing area can also be an important economic factor given that travelling larger distances to another port incurs more expenditure for fuel and working hours.

In the case of Jabuka/Pomo Pit, different types of closures apply to different types of fishery. There is a list of vessels in each of the countries that are allowed to fish based on the history of the vessels and the position of the ports. Fishing vessels that have a history as traditional users of the area are given an advantage.

Solution 4: Communicate the value of MPA to fishers

Marine protected areas (MPAs) and their values are usually not well known to the public, or have little aesthetic value. Therefore, as one of the first steps, informing everyone involved about these areas is of vital importance[41]. Scientists can have an important role in communicating the most up to date information, which can serve as a basis for a more informed cross-sectoral discussion and decision-making. The presentation of research results by a third party rather than the MSP authority may lead to a more balanced discussion. In some cases, it has been beneficial for authorities to engage with fishers and fishing associations prior to joint meetings with other stakeholders. These smaller and more informal meetings are a useful way of becoming familiar with the fishers' concerns, their traditions and ways of defining fishing, and can be a first step towards establishing common ground for conflict resolution.

Solution 5: Estimate of the bio-economic effects of closure(s), in particular for purposes other than fisheries conservation

Estimating the bio-economic effects of fishery closure(s) is a useful way of determining the utility of this management measure and its socio-economic impacts. While it is helpful to monitor the effect of a measure once it is in place, it is equally useful to model different scenarios in anticipation of closure.

Models are available that estimate the impact of an envisioned measure through time (e.g. in 5 years). They can take into account various parameters, such as the impact of a suggested closure on each fleet, the impact on different ports, the distribution of benthic communities and impacts on benthic habitats. Taking into account any likely economic impacts (and their expected changes over time) is of particular relevance.

The DISPLACE tool[42] , developed by DTU Aqua, is one example of such a tool. It is a complex model that uses data for each vessel, integrating all available stock data, fleet data per harbour, the technical characteristics of the vessels, the market price of the fish, fuel consumption, trawl and survey data, and other economic data, etc. The output of the model is a list of bio-economic indicators that can help the decision making process in regards to fishery closure. The results obtained with DISPLACE have been used in several meetings with stakeholders (FAO, AdriaMed, GFCM; projects: ECOAST, DORY, ECOSEA) to show the bio-economic effects of spatial restriction for some type of fisheries, namely bottom trawling and rapido trawling.

Solution 6: Implement alternative fishing methods

MSP is not a tool for fisheries management and conservation, and conflicts could result if it were used in such a way. At the same time, the MSP process could be a useful platform for discussing the more technical measures of fisheries management, which could help to reduce conflicts between fishery and area-based marine conservation. For example, the MSP process could be used to have

[41] European Commission (2006)

[42] DISPLACE project. Available at: http://displace-project.org/blog/

a discussion with fishers on optimum mesh size for selected target species, the choice of hauls or less damaging fishing equipment. Each of these technical measures comes with different costs and benefits. For example, 12h hauls need two round trips per day to the area concerned, which doubles diesel costs, so changing to 12h hauls is only usually only economically feasible if fishing sites closer to the port are chosen. Different fishing techniques are also associated with experience and costs. For example, an investment in accessory equipment for longline fishing can be largely covered by one season of fishing. However, the real difference of cost of fishing practices lays in extra hours of work that added to the working day. Although it is not up to MSP planners to determine mesh sizes, the MSP process can be a useful point of entry into discussions on various management measures and what would work in each specific context. There is unlikely to be a one size fits all solution given the many different types of fishery and broader ecological and socio-economic contexts. Whatever the local context, it is important that technical and spatial measures work in synergy.

5. Outlook: Future trends and developments in the sectors (with a view to the likelihood of conflicts arising in the future)

5.1. Future trends in commercial fisheries

More environmentally friendly fishing practices may mean less bottom trawling as this has major environmental impacts, therefore reducing conflicts with environmental protection. However, shifting to static gear may mean environmental impacts which are different but not less important: gill-nets can kill harbour porpoises, dolphins and diving seabirds. There is also a fundamental shift within the industry, with fewer persons entering the profession and an overall reduction in the size of the fleet. Synergies may increasingly be explored between the two sectors, also considering spill over effects and temporal closures, leading to new concepts of multi-use.

5.2. Future trends in area-based marine conservation

Those calling for increased protection of the marine environment will most likely call for the establishment of more MPAs as well as request re-routes in sensitive areas. Technology will also play an increasing critical role in the protection of marine biodiversity as proven with the use of new satellite systems such as the REPCET software. Additionally, as Member States are required to implement measures to achieve the Good Environmental Status (GES) of the marine environment, as required by the Marine Strategy Framework Directive (MSFD), is it expected that new measures will be taken by European countries for improving the quality of the marine environment and at the same time reduce impacts on the fragile ecosystems and animals. The future of most MPAs will also see an increasing implementation of the Ecosystem-based Approach (EBA), which will improve the management of MPAs such as the Pelagos sanctuary and will thus be able to deliver better protection for cetaceans and other threaten species. Finally, the increasing use of technology and the availability of new instruments will contribute to data collection of endangered species and will enable policy-makers and related players to make decisions based on scientific data with the aim to reduce anthropogenic pressures on the ecosystems.

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