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## 1. Background

The CFP has succeeded in curbing fishing effort and rebuild fish stocks. But, while the number of fish stocks at or under MSY is increasing, the actual productivity of these stocks - in terms of amount of fish generating income and food - is highly out of tune with their potential.

The realisation of the CFP reform is impeded by implementation failure and by the compliance gap resulting from failure to legitimize and control full catch accountability according to article 15 in Regulation 1380/2013.

Full catch accountability must be established for the CFP to succeed. It is the prerequisite for fish stocks to be managed at MSY, it is the first condition for the Landing Obligation, it ensures a level playing field for European fishermen and it incentivises sustainable fishing methods as fishermen will use and improve methods to avoid unwanted catches.

The main barrier for full catch accountability is loss of income. The choke problem threatens fishermen's ability to catch the quotas available. Hence their incentive to discard non-quota catches. For that reason it is necessary to identify and deal with the barriers to accountability, notably related to the choke problem.

This paper offers an annotated catalogue of barriers to full catch accountability and a discussion of concrete solutions. Results based management is used as the overall strategic policy approach.

## 2. How accountability can work

The CFP principle of full catch accountability entails that the yearly EU TAC/quotas are fixed without deductions for discards. The chosen total fishing mortality is translated directly into the TAC and resulting Member State (MS) quotas.

Fishermen must count all catches of quota species against their quota holding. Ideally this is documented for each vessel through a reliable system such as Remote Electronic Monitoring (REM).

For many vessels REM is not an immediate solution. In this case it is necessary to set aside quota-buffers that reflect discard levels in non-REM fisheries. This can be done in the yearly TAC/Quota Regulation or in national quota management. The most practical tool to ensure Member States' catch accountability is to establish a last-haul account mechanism on national level supervised by EFCA.

The effect of this approach is:

- Accountability and thus a level-playing-field is established either through REM or through a statistically based account of catches in fisheries not covered by REM. Irrespective of REM-use or not each MS account for the total fishing mortality.
- Incentivise Member States to apply REM in order to reduce last-haul catch adjustments.
- Incentive fishermen to fish selectively and to demonstrate accountability by using REM.
- Incentive to fish selectively and improve monitoring in order to improve the statistical documentation of reduced discards for fleets not using REM.

Last-haul monitoring used extensively through 2018 demonstrated sizeable differences between reported catches and actual catches. It is now time that the tool is adapted and applied as an account mechanism to ensure Member State compliance with the stipulated catch reporting in the Control Regulation.

The TAC's set for 2019 have been increased to reflect full compliance with the landing obligation. It is commonly known that discard patterns are unchanged and that Member States have not taken steps to include non-accounted catches in their reporting to the Commission according to the Control Regulation.

The last-haul mechanism should be included in the revised Control Regulation and it should be applied for the most relevant fisheries, now in 2019 to ensure that practise is aligned with law.

The art. 109 text below illustrates how the principle could be explicated in the regulation.

*Article 33 catch registration* (Commission's proposal)

2. Before the 15th of each month, each flag Member State shall submit electronically to the Commission or the body designated by it, the aggregated data:

(a) on the quantities of each stock or group of stocks caught and kept on board, and on the quantities of each species discarded, in live-weight.

*Art 109 validation* (NEW text proposal)

Member States shall validate and correct the aggregated registered catch data from stocks where quotas are utilised in excess of 80%. The correction is done by comparing size composition in catches observed through last-haul monitoring with size composition in catches registered through logbooks and landing declarations. The Commission may, by means of implementing acts, adopt formats for the validation and correction of data referred to in this Article.

### 3. Removing barriers to accountability

For the fisherman, the main barrier to assume accountability is loss of income. This problem is caused by:

1. Adverse regulation.
2. Chokes, ecosystem characteristics and exemptions not properly used.
3. Rigid allocation of fishing opportunities.
4. Low adaptability in some fleets and fishing practises.

#### 3.1. Adverse regulation

Management of fish stocks is conceptually simple: To catch the maximum amount of fish that a stock can provide year after year in such a way that lets juveniles grow to value before they are caught. In the reformed CFP, the first is obtained by MSY and the transition to full catch accountability - catch quotas instead of landing quotas. This leaves the issue of size composition in catches. Up to now the CFP has promoted a very simple size paradigm: "Fish only the largest fish". Through technical regulations, gear rules, by-catch rules etc. the policy level has guided fishermen's activity at sea in detail. Selective harvesting is complex, and it has become clear that the distance between prescriptive regulations and the fisher's appreciation of the situation at sea is causing unacceptable waste of resources and poor economic returns.

To achieve optimal utilization of the resource the fisherman should be able to choose how to fish, according to the variability of the circumstances at sea. User-driven innovation would then take the lead in developing selective fishing methods. For that reason, free choice of gear must be the guiding principle - except for regulation to protect sea-bed and habitats. This allows fishermen to deal with the choke issue on their own terms. Full catch accountability already applies; the question is what the effect will be in relation to size composition, and to what extent it should be managed.

The answer is to introduce catch metrics. Technical rules are an indirect way of managing the fishing mortality; catch metrics *remove* the need for detailed technical rules. Focus lies instead on size composition of catches rather than on the gear and the fishing method. Catch metrics define an *output* result, for instance a given proportion of the catch below Minimum Conservation Reference Size (MCRS).

Catch metrics already apply in the advice given by ICES when targeted mortality is translated into advice in tonnes. If the average age/size of the fish in a stock decrease over time, ICES will reduce the TAC advice to counteract an increasing mortality.

The use of catch metrics at EU and Member State level will depend on the fisheries in question. A simple approach is to require a maximum percentage (e.g. 10%) of the catches to be below MCRS. Another more precise tool is to set a maximum fishing mortality that Member States' catches may induce on the stock. With a maximum fishing mortality, the Member States may distribute the mortality according to national priorities by allowing some fisheries to include smaller specimens - for example in mixed fisheries - on condition that catches count with a factor higher than 1. This can be done via the market size norms.

In single species fisheries, such as cod, where the big fish are relatively valuable, there is no need to take catch metrics on-board. Free choice of gear is likely to reduce mortality on its own, and [Trials](#) suggest that this occurs. Even in fisheries where free choice of gear may incentivise catches of smaller fish there is no need to use 'belt and braces' when catch metrics are employed. REM and the standard provision to sort fish according to size will ensure a real time picture of fishing mortality and size distribution in the various types of fisheries.

In single species fisheries where price-relations do not favour big fish, it could be argued that it is acceptable to allow smaller fish to be caught (at a lower TAC) with the same, or even an increased, economic turn-over. This paper does not discuss Balanced Harvesting, but note that catch metrics can serve a variety of harvesting strategies. The sanction - or pay-back, would be to reduce quotas for the subsequent year for a Member State exceeding either the TAC or the mortality ceiling. This tool is in the Control Regulation. If Member States, nationally or on a regional level, wish to introduce gear regulations to influence mortality, they may do so.

The 'catch metric' approach allows for:

- free choice of gear,
- tailoring catch accounting to the individual fisheries metiér
- tailoring catch accounting to the changes in species and size composition (for example in situations with large recruiting year classes).

This makes the vast number of provisions regarding gear type and use superfluous, and it allows for externality costs to be neutralized.

The use of catch metrics is in accordance with the reformed CFP. It is in effect a logic consequence of full accountability, which is a "what you catch" output management; as opposed to the previous "how you catch" input management.

Catch metrics will incentivise the fisher to continuously optimise methods and gear, and science will benefit from fishermen being new 'customers'. Catch metrics with REM makes the ban on selling fish under MCRS for consumption superfluous. The hinge factor for this management to

work is full catch accountability as defined in article 15 (1380/2013), including the use of REM covering a substantial part of catches.

### 3.2. Chokes and exemptions.

The CFP includes various exemptions to alleviate the choke species problem. These exemptions should be broadened as much as possible in respect of the overarching principle of full accountability. The tools should also incentivise innovation in fisheries, as fleet structure and fishing methods will have to adapt to the changed playing field. This change should be driven by the economic interests of the industry.

#### Inter-species flexibility

This provision allows catches that are either a) caught in excess of quotas or b) catches of species of which the Member State has no quota, to be deducted from the quota of the target species. The rule goes against the accountability principle and it entails a double book-keeping where authorities count catches against the quota for one species and biologists count against another species. The use of the rule will imply that fishermen gain an incentive to “fill-up” with non-quota catches even if the need is not there.

Rather than accepting non-quota catches, such occurrences should be dealt with under de minimis, or in an amendment to article 105 in the Control Regulation (1224/2009). The pay-back should then take effect as in Commission Reg. [2017/2309](#). This however does not remove the problem which in many cases relates to quota allocation mechanisms. This is discussed later.

#### De minimis

Up to 5% of the annual catches can be exempt from the landings obligation. This provision applies i.a. when selectivity is difficult to achieve and there are provisions for the documentation of catches. Catches under the provision shall not be counted against the relevant quotas; however, all catches shall be fully recorded.

Taking into account the ongoing high levels of discards, and the transitional problems moving to full catch accountability, this paper considers the de minimis rule as helpful in choke situations. It should apply for REM vessels only in order to ensure documentation of the recording.

Catches being recorded - but not counted - against individual quotas respect the need for correct data for advice. Subsequent TAC/quotas will be reduced and the “cost” thus paid by all fishermen with quota access.

### Year-to-year flexibility

‘Year-to-year flexibility’ does not seem a strong tool to resolve choke situations. It is useful in the sense that it departs from the “use it or lose it” approach, and it could be explored further in context of Multi Annual Plans, a real-time based advisory system and a more continuous management than the present calendar year approach offers.

### High survivors

The landing obligation does not apply to species for which scientific evidence demonstrates high survival rates. Determining what counts as a high survival rate poses a challenge to scientists due to the high level of variability in the survival rate, reflecting ever-changing conditions (fishing gear, trawling-time, season, age, treatment on deck etc.). [STECF](#) stated: “Survivability – a huge debate”. This has led to both a decision stale-mate and some non-controllable rules such as time-length, depth of towing and requirement of immediate release. This problem can, however, be properly addressed on the basis of the mind-set inherent in the CFP, which allows costs and benefits from discarding to be internalised in the catch quota management.

The solution is to provide an exemption for species considered to be sufficiently capable of survival. The exemption then applies as follows:

1. Releasing is allowed for fish under MCRS.
2. Released catches count on the vessel quota with a percentage of the catch that reflects expected average mortality for the given species.
3. Vessels with REM can use the exemption.

This approach will ensure that fishermen are accountable for the mortality they inflict on the stock, and, more importantly, they have the incentive to minimise unwanted catches and discards thereof. In effect this approach is robust enough to allow for free discarding of fish under MCRS, which underpinned the large-scale Danish REM trials for 8 years.

The approach entails that catch of a species with an average survivability of 40% will count 60% against the fisher’s quota holding. Setting the survivability (and hence the catch account) allows for some useful modifications. For low level stocks the account can be set at a precautionary high level. On the other hand, for a sound stock such as plaice where the phasing-out of discards in the sole/plaice fishery is difficult, it is possible to set a relatively low account percentage provided the actual catches are recorded. The resulting next-years TAC reduction will then be paid by all fishermen, including low-discarders. In the long run, letting the “next fisher” pay is not viable. The long-term answer to the problem is to innovate methods that compare with best practises, or suffer the economic extinction of the fleet.



## Low-volume chokes

The ecosystem poses difficult choke problems for low-volume and protected species. A lot is done to develop technical solutions, but it is also necessary to consider management of these species in respect of the various sea basin characteristics. In this paper, low-volume species are defined as species that will choke even with an optimal allocation between all fisheries irrespective of nationality. This includes protected species. Special tools should be considered for low-volume species where transferability tools have been used to the full extent. With this condition the following tools should be applied in order to underpin accountability:

1. **For quota regulated stocks** the TAC should be fixed at a level that takes account of the mixed fishery and which is above the precautionary approach (art. 2.2. 1380/2013). Discard exemptions may apply depending on species survivability. The count against quotas is set on a precautionary high level, and it may be differentiated according to fishing method and best practise documented through REM.
2. **For non-quota stocks** not under analytical assessment, it is necessary to establish reference points and trigger indicators with regard to acceptable fishing mortality. It is not advisable to manage these stocks within an “others” category, as it may result in overfishing of individual species. Discard exemptions as under point 1.
3. **For protected species** it is advisable to define a catch or reference limit, to oblige all catches to be released, to record all catches and to count these against the limit with a suitable factor reflecting survival for the species in question.

This approach will ensure a given level of protection of the species, it will ensure accountability, it will maximise economic output in mixed fisheries, and it will stretch the quota holdings through a properly defined discard exemption.

### 3.2.1. Exemptions from control measures and accessory regulation

The Control Regulation and a number of control provisions in other regulations are developed before the reformed CFP. REM offers a full and continuous documentation of all important control aspects. The REM solution should be integrated with the upcoming revision of the Control Regulation and REM vessels should be exempted from a number of control provisions such as stowing and notification of gear, restricted landings to designated ports, prior notification rules etc.

Management and control of fleet tonnage and engine power saw the light with the MAGPs (Multiannual Guidance Programmes) in the mid-eighties. The aim of the programmes was to curb



overcapacity, excess fishing effort and mortality. This link between overcapacity and excess fishing mortality will cease to exist with full catch accountability and the regulation of capacity could exempt fleet segments covered by REM.

### 3.2.2. Quota substitution

For a number of stocks ICES [present](#) a TAC “range” scenario that minimizes TAC mismatches in mixed fisheries. The scenario returns a fishing mortality by stock which, if used for setting single-stock fishing opportunities, may reduce the gap between the most and the least restrictive TACs, thus reducing the potential for chokes. However as the TAC’s are split into Member State quotas the range approach should be used on MS level to make sense. Three models could look as follows:

1. Set all TAC’s for the relevant stocks in the mixed fishery at the upper level and accept that some Member States may not be able to utilise their catch opportunities unless they swap.
2. Double TAC principle
  - a. TAC’s are fixed at the upper level calculated on a single stock basis for relevant stocks occurring in the mixed fishery.
  - b. A single weighed and aggregated multispecies TAC is set at the balanced level covering all the relevant stocks in the mixed fishery. Weighing can be done on basis of prices, cod equivalents or other.
  - c. The Individual Member State may freely choose a suitable quota combination of the individual species in the aggregated TAC on condition that both the single-stock TAC and the aggregated TAC is respected.
3. Set all TAC’s for the relevant stocks in the mixed fishery at the upper level and perform a value-balanced in-year quota exchange between Member States that minimises the choke effect for the year.
  - a. If it is done in the TAC/Quota regulation it will raise a (forbidding) Relative Stability question
  - b. If it is done as a voluntary exchange, only MS that align with the calculation may access the upper level TAC other MS must satisfy themselves with the quotas based on ICES TAC advice.

### 3.3. Allocation and chokes

Transferable Fishing Concessions (TFC) may be seen in context of permanent fleet adaptation or day-to-day matching of catches with quota holdings. The first entails the transfer of permanent rights, typically in the form of a given share of a national quota. The second type of transfer is an in-year leasing - or swapping; there are no changes in share ownership.

TFCs are a contentious management tool. Discussions should focus on the ability of TFC designs to meet defined objectives, and to assess the dynamic consequences associated with that. Our Western economy is a market-based, where half of the turn-over is spent on policy prioritised areas. TFCs can produce wealth and be managed to deliver to socioeconomics at the same time. This paper, however, focuses on in-year transferability as a means to contain chokes. The considerations are equally valid in relation to climate-migration of stocks.

#### 3.3.1 Transferability within EU and Member States

Member States have wide opportunities to establish transferability, illustrated by the following:

##### a. Producer Organisations & cooperatives

PO's are managing fishing allocations in some Member States. The flexibility with regard to matching catches with quotas depends on the individual PO. While the system limits the freedom of the individual fisher, it may prevent fishermen from establishing a 'corner of the market' of sensible choke species. A number of Member States employ variants of the PO-pool under the Common Market Regulation (CMO). Some fishermen have established coop-pools outside the CMO.

##### b. TFC-pools

This type is a lease/swap "home-banking system" that allows individual fishermen to swap and lease quota according to his own choice, and depending on the demand-supply situation. Danish TFC pools are managed by the industry. The Fisheries Agency sees each pool as "one vessel" in the sense that vessels are allowed to overfish their individual quotas as long as the pool total is not exceeded. This allows fishermen to land and sell fish without having a quota and retrospectively lease-in the amount needed. The system does not have a formalised protection against speculation in chokes, but, as with a fisherman-managed system, social pressure may apply.

##### c. Risk-pools

Risk pools are used in USA. Here fishermen combine their quotas of overfished species and chokes to reduce the risk for the individual fisher. Members of the pool who catch the relevant species

are covered by the pool. The condition for participating in the pool is that spatial fishing plans are adhered to. These plans are updated by the fishermen for example through [eCatch](#): *“Knowing where by-catch events occur is one way to avoid problems. eCatch gives captains an easy way to capture the location of their by-catch events, visualize them on a map, and share with other members of their local community. eCatch operates on a “give get” principle, meaning if you choose to share your by-catch locations you will receive a generalized map of by-catch from other eCatch users in your fishery.”*

Sharing of knowledge and by-catch avoidance tactics is relevant, even if sharing of quotas is not involved. Spatial management may be developed in order to direct fishing effort in the increasingly dynamic ecosystem. Spatial management, including real-time closures and precautionary areas, should be considered as a tool to inform fishermen’s decisions rather than obliging them through a new layer of regulations.

An example of this is the [pilot project](#) in the Bristol Channel, which is providing daily reports of spurdog by-catch, using a grid reference system. An REM system, supplemented by vision software, may further qualify conditions regarding by-catches and automatize sharing of information in real-time.

### **Practical innovation needed**

The design of a pool may well combine elements from the various types mentioned above. Member States and fishermen should not hesitate to discuss pool objectives and design elements. The basic design must be based on sea basin characteristics, fisheries (métiers), level and type of fisher-organisation etc. Technological innovations and developments will also offer new opportunities. In some years, blockchains may automatically show the optimal real-time distribution of quota holdings in defined systems and allow for rule-based, or personal, transactions in a peer-to-peer industry-wide network, operating within appropriate national boundaries.

### **3.3.2. Transferability between EU Member States**

Member States may, after notifying the Commission, exchange all or part of the fishing opportunities allocated to them (Art 16.8 1380/2013). Even though this provision is widely used already, the options for more advanced uses have not been explored.

In general, Member States have been reluctant to consider swaps beyond the bilateral 1:1 model, where the quota exchange between the two Member States is in balance with regard to amount or value. More effort should be done in order to establish flexibilities with regard to transferring quota. Another major problem appears to be the reluctance to open a discussion on Relative Stability between Member States. Allocation of quotas between groups or individuals at the

National level (National quota management) may also hinder transnational swapping. A technical evaluation of various models might facilitate new solutions; for example the ones floated here:

#### **a. Roll-over arrangements between Member States**

Member States may, on bi- or multilateral bases, establish swapping arrangements that even out imbalances due to Relative Stability. The swap could be concluded every year following the December TAC/quota decisions. This solution has already been in use.

#### **b. EU buffer**

The 'inter-species exemption' is an example of a negative impact of a regulation (however unintended), which is used in situations where the Member State has no quota for a choke species. The problems associated with this could be alleviated through swaps or even unilateral transfers. A buffer could be set aside at the EU-wide level in the yearly TAC/quota regulation for the relevant stocks, which is then used to cover non-quota catches. Such catches should *still* be discouraged, however, through an amended article 105 (1224/2009) as this buffer would only be used in extreme circumstances. Alternatively, and in full respect of Relative Stability, the buffer may be used as a basis for continued exploitation of the target species, while the choke species itself is counted against the buffer and discarded.

The buffer would incentivise Member States to solve the problem between themselves before a buffer is established.

#### **c. Unilateral transfers**

In some areas, Member States have choke issues on high volume stocks on which they do not have a quota. The direct consequence of this is unaccounted catches and discards. As long as this failure goes uncorrected, it will block proper documentation of catches. Member States that *do* have sufficient quota of the stock in question may offer a quota transfer for free, on the condition that all catches are accounted for, with suitable controls applied using REM where appropriate. Transfers lower than the level of unaccounted catches would benefit all players, as unwanted catches would cease to tax the TAC.

#### **d. Transnational pools on Member State level**

Member States spend considerable time on bilateral talks regarding possible swaps. Instead, they could announce their 'demand-supply' profile on a common webpage in order to create transparency as a basis for swaps. The pool may be served by an algorithm that suggests more complicated swaps involving several Member States. The model could be considered to cover 3<sup>rd</sup> countries such as Norway and UK after Brexit. Relative Stability would then be an issue.

#### e. Transnational pools at the individual fisherman level

It is possible to establish a transnational pool, where leasing and swapping of in-year quotas takes place between individual fishermen, or their POs, in full recognition of Relative Stability and the Member State prerogative to manage national quotas.

The outline is that:

- The Member State wishing to participate at the beginning of every quota year decides the acceptable quota share that may be leased out by their individual fishermen, or PO's, and for the stocks chosen by the Member State.
- The quota boundaries for the Article 16 swap is registered with the Commission and each realised swap is subsequently registered.
- The MS may allow free leasing within the quota limits and other conditions (such as maintaining a pre-defined value balance).
- A technical facility is established to manage the pool. A web based facility allowing for relevant boundaries to be attached to the individual fisher or PO participating in the system will function like a home banking system. Such a [system](#) is in operation.

This may need a flexible interpretation of art. 16 (1380/2013).

#### 3.3.3. Transferability with third countries

The CFP aims to ensure sustainable exploitation of stocks shared with third countries through a.o. the exchange of fishing opportunities (art. 33.2. 1380/2013). Brexit makes it relevant to consider the opportunities for a more flexible exchange system. Relative Stability and the Commission's negotiating prerogative will, however, be put in jeopardy if Member States can swap with 3rd countries. Given that the main choke problem in some areas is associated with allocation rather than biology; more thinking should be done in this area. All exchange arrangements must be based on a level playing field. Mandatory REM should be considered for the various types of transfer systems in order to ensure fair and transparent competition.

#### 3.4. TAC advice

Alleviating the choke problem depends on advice that makes sense to fishermen in real-time when they are fishing. The current system is not able to provide advice that serves both the policy objectives and the earnings of the industry adequately.

The current data source for advice is insufficient in terms of data amount, data quality and data actuality (real-life). The current static approach to modelling of advice fails to fully include

dynamics (climate). The current advisory process is complex, being based on layers of working group and committee work over an extended period. The result is advice reflecting data often up to two years old, and possibly an outdated ecosystem situation.

### Why not a daily Fish-Forecast?

Machine learning seems to offer a viable comprehensive solution to the problem. Increasing amounts of data can be sampled, distributed and computerised in real time and at low costs. Machine learning may:

- Offer instant and continuous stock assessment.
- Use data sets that cannot be processed in current models.
- Use data from fishing vessels with fewer demands on sampling protocols than now.
- Offer dynamic adaptation to climate and other baseline changes.

## 4. Documentation and accounting of catches

Catch Quota Management for Fully Documented Fisheries (FDF) using REM has been extensively trialled in Denmark and UK (2009-2015). Germany, The Netherlands and Sweden have participated as well.

The trials were based on a very simple incentive driven logic: A fisher counting all catches against his quota holding, and documenting this, received a quota increase that reflects the discard level for the stock in question. Numerous reports have deemed the trials successful. REM is effective, selective fishing has improved and discards have dwindled to insignificant levels.

From 2015 full catch accountability has been gradually introduced as a CFP requirement. At the same time, TAC's are set without deduction for discards based on the logic that fishermen have to count all catches. This logic is correct, except for the fact that unaccounted discarding continues. The consequence is that fishing mortality increases, and the pursuit of MSY becomes a theoretical exercise. Increases in TAC's may, in some areas, lead fishermen with sufficient quota to increase high-grading. Control of at-sea behaviour is very difficult. High grading of fish has been illegal since 2002, but it is well known and statistically proven that large quantities of sellable fish have been illegally discarded.

#### 4.1. Remote Electronic Monitoring (REM)

The following account provides a workable REM solution. It includes findings from the WWF report [\*Remote Electronic Monitoring\*](#), published in September 2017.

No other method of monitoring is able to record the “decision point” where a fisher decides to retain or discard a fish. Well-designed catch handling procedures can also allow the amounts of fish retained and discarded to be quantified and measured, thus removing the need for human observers controlling and gathering data at sea.

REM has been trialled on a range of vessels, and in different fisheries, including whitefish trawlers, Nephrops trawlers, gillnetters, longliners, beam trawlers, pelagic trawlers and under-10-metre vessels. The conclusion of all these trials was that REM – when coupled with CCTV - can allow fishing effort to be monitored, catches to be verified and discarding to be detected.

REM has demonstrated itself as an efficient compliance and scientific tool, capable of providing the observations required to monitor adherence to the Landing Obligation, whilst also supplying large quantities of good-quality scientific and management data at the same time. The main benefits from using REM are:

1. **Effective**

REM is the only method available that can effectively monitor the Landing Obligation. No high-grading regulations were enforced before the introduction of REM. The system is becoming intelligent (e.g. optical reading of species and sizes) and it can be coupled with a risk based algorithm (e.g. singling out catch compositions) that call for in-person control.

2. **Delivers more for less money**

It is necessary to establish comprehensive at sea controls to monitor the Landing Obligation. An observer programme is expensive and requires large numbers of observers; while REM will be less expensive and less intrusive, and will produce data that can be used for multiple purposes. REM is economical and efficient, and technological developments makes it increasingly affordable, even for very small vessels.

3. **Increased and improved data**

REM allows data to be collected over a longer period, and is being used in several UK and DK research projects. Rather than sending observers to sea for one or two research trips, the fishermen can collect the data over a longer period, record the data and imagery using REM, and have the data and results verified by an onshore analyst. This removes bias introduced by seasonal variations, or from having an observer on board. It increases the timescales of a



project: data availability goes up, costs of collecting the data go down.

#### **4. Faster access to data**

Currently observer coverage for scientific research purposes is low but costs are relatively high; and the data takes time to be manually entered on to a database, checked and then formatted for annual stock assessment purposes. This process can take a year to complete. REM sensor and positional data can be available in near-real time, while video review data can be completed and uploaded shortly after receipt of the raw data. This in turn can allow managers and fishermen to respond more quickly to events on the fishing grounds.

#### **5. Alignment with market requirements**

REM can be integrated with traceability and thus offer not only traced catch registration but also validation of the information. In this way the “stamp” of sustainable behaviour can be integrated in the production line, from catch to consumer, rather than being an accessory feature offered under certification schemes such as MSC.

### **The Norwegian discard ban**

The Norwegian discard ban has repeatedly been pointed out as a model for the EU. This is however not a helpful comparison. The Norwegian system entails rules such as: shift of fishing grounds and depths, gear, by-catch allocation schemes, accepted overfishing and price neutralizing systems to contain overfishing. Furthermore, Norwegian stocks, fisheries and traditions are uniform compared to the situation in EU; *and* Norway has more inspection vessels. The “cultural” phasing-in of the Norwegian system took several years and, even though the Norwegian system is superior to the former EU discard regime, discarding still occurs when changing conditions are in favour of this.

The principal difference lies with the Norwegian system as a ‘command-and-control’ system with a high level of fisher acceptance, while the EU approach is based on full accountability and incentives rewarding this; including results-based management.

#### **4.1.1. REM operation and sanctioning**

##### **Operation**

The technical operation and prospects for cost efficient and more intelligent systems are covered in a number of reports and knowledge exchange fora, such as <http://eminformation.com/>. REM will allow for an important extension of the risk-based control, which has mainly focused control on fishermen with a history of non-compliance. The current on-line registration of data from logbooks and sales notes makes it easy to study the registered catch compositions of individual

vessels. At the simplest level, a catch with only large fish would be worthwhile checking for discards by looking at the video frames from the hauling of the gear, while “normal” catches could be checked at a low frequency. The risk factor can be determined by algorithms that continuously assess catch compositions related to time, area and gear.

REM is becoming more and more intelligent. Recent advances streamline data, as sensor systems define the critical control points – e.g. hauling of gear and gutting fish - as opposed to periods of steaming, meaning that a large amount of footage does not have to be inspected.

### **The burden of proof and sanctioning**

The voluntary phasing-in approach entails a contractual situation rather than top-down management based on legal sanctions and the burden of proof. Reversal of the burden of proof becomes a real opportunity.

Transgressions of conditions for REM vessels may be sanctioned over the REM-license; the “REM-contract”. In cases of non-compliance, licence conditions are tightened or the license is completely withdrawn for a period, profits may be confiscated etc. Ultimately the vessel loses the REM-license and falls back to the supervised system.

In this approach, it is the responsibility of the fisher to ensure the documentation required. In case the REM malfunctions he has the responsibility to produce a credible explanation or suffer automatic consequences.

Reversing the burden of proof, and attaching sanctions to licenses and profits instead of relating them to individual Member State’s legal practises of fining and confiscation, will establish a level playing field with regard to Member State sanctioning.

Full documentation is essentially the fisherman’s demonstration of compliant practises - much in line with the thinking behind certification. The fisherman becomes responsible for the documentation and the fisherman should, accordingly, be the owner of REM data.

### **4.1.2. Costs of using REM**

REM is becoming the most affordable and efficient option for monitoring catches and collecting scientific data. The cost of reviewing the whole UK >10m fleet at 10% video review has been estimated to €5.6million for 2017. This represents a 22% reduction compared to 2015. Conversely, the costs associated with traditional monitoring and scientific data-gathering methods are increasing.

The costs of using an REM system for one vessel are estimated to be € 5,960 per year. This includes the purchase of hardware and analysis software, full installation, maintenance and the inspections review of 10% of the video footage.

Financially, every UK vessel over 10m in length could be installed with REM and have 100% of the sensor data, and 8% of the video, reviewed for a cost equivalent to 25% of the 2015 monitoring, enforcement and observer programme budget (UK data). The financial argument clearly shows that REM is a viable option.

Source: [Remote Electronic Monitoring](#), September 2017.

#### 4.2. Aligning documentation, control and certification

The CFP includes rules to ensure traceability and support responsible consumption of products marketed in the Union. “All fisheries products shall be traceable from catching or to retail stage” (Art. 58 of Council Regulation 1224/2009). The provisions were to be adhered to by 1<sup>st</sup> January 2012. In spite of community financing, the system has only been partly implemented through a variety of individual systems in Member States.

Traceability establishes a registration path of responsible conduct, which is important for the public control and management of resources, as well as for certification schemes - [MSC](#) already uses traceability. The critical problem of traceability is whether the information put into the system is correct; the most critical issue related to the CFP is whether all fish are counted and kept on-board. Currently, Member States do not control this, and neither the Commission nor the European Parliament has prioritised control of this core CFP principle. MSC assess sustainable practises on the basis of anecdotal information, control reports and similar uncertain information and has not made a move for accurate documentation as required in the CFP

REM ensures a validation of all catches taken by REM vessels. It will allow for a full review of all log-book registration and offer a one-string data platform that may be used by control as well as for certification. In effect, REM validated and traced fisheries - harvested at sustainable levels - would not require an expensive and time-consuming process of certification to qualify as a sustainable fishery, and retailers satisfied with their own brand might suffice with the REM'ed and traced documentation.

## 5. Afterword

The concept of 'Natural Capital' has gained support over recent years. It provides a new lens through which to view the way we manage natural resources. From the standpoint of society, the objectives of Natural Capital, management of fisheries should be to:

1. **Ensure accountability**

Accountability is a "first". The setting of utilization levels has little meaning if they are not observed. Furthermore, accountability ensures a level playing field with regard to the balance between economic results and environmental impact. Human activity often results in unexpected negative costs that end up being paid by society or other users of the natural resources who did *not* choose to incur these costs (an 'externality'). Discards for example result in reduced TAC's where the reduction is paid by all fishermen including those with little or no discards.

2. **Ensure sustainable use**

Sustainability is often understood as a principle to ensure the *protection* of natural resources. Sustainability is however a concept for *utilization* of resources to the long-term benefit of mankind. The distinction is important. "Conservation" entails restricting the use of resources while "utilization" applied on basis of accountability spur optimization of the resource.

3. **Ensure economic progress**

The Brundtland definition of sustainability sees economic progress in context of fair distribution, with attention given to developing sectors. The CFP intends to contribute to coastal economic development by including social priorities.

Each of the policy objectives are embedded in the CFP and the strategy that can make them unfold is accountability and results based management.