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NSAC Advice on the functioning of the Landing Obligation

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1 Background

The objective of the 2013 reform of the Common Fisheries Policy (CFP, Article 15 of [EU 1380/2013](#)) was a progressive elimination of discards in the EU fisheries through the introduction of an obligation to land and count all catches. The landing obligation for all commercial fish species in the North Sea was phased in by 2019. To render the implementation feasible, exemptions from the landing obligation for specific situations were granted following Joint Recommendations from the EU Member States in the North Sea (the Scheveningen Group), such as exemption in cases of demonstrated high survivability rate (high survivability exemption) and where costs of handling unwanted catches would be disproportionate (de minimis exemption).

According to Article 49 of the CFP the Commission shall report to the European Parliament and to the Council on the functioning of the CFP by 31 December 2022. In view of the preparation of the said report, the NSAC undertook to engage in discussions regarding the on-ground experience with the landing obligation with the aim to understand the efficacy and effectiveness of this management measure in providing solutions for improved management solution and compliance.

In light of this, the NSAC Landing Obligation focus group was tasked with the production of the NSAC advice on the experience with the Article 15 of the CFP (the Landing Obligation). Following exchanges in the focus group, it was observed that a wider forum could spur the discussion on efficacy of the measure in improving the status of fish stocks through improved selectivity. To facilitate such topical discussion a workshop was organised in Brussels on 17-18 January 2023, bringing together 46 stakeholders, directly or indirectly affected by the landing obligation – legislators, users (fishers), scientists, control authorities, environmental NGOs, and other fisheries stakeholders and observers. The purpose of the event was to identify the landing obligation's positive effects and shortcomings in the North Sea and actions that could render it more efficacious and pragmatic.

Since the landing obligation was first introduced as a tool for improving selectivity in 2013, the NSAC has produced a number of advice papers¹ identifying and flagging a list of issues, which have in the years following the implementation, and with different levels of success, been addressed by the legislators.

This paper aims to condense years of deliberations in the North Sea and provide the legislators with a succinct overview of persisting issues, their implications for sustainable management and possible ways to overcome them by way of 1) simplification of existing rules and 2) application of technological solutions where these are available.

The paper is comprised of five parts following the Background. In the first part, we present the alternative systems of Iceland and Norway, from which we drew some inspiration for the second part. The second part focuses on the experience with the Article 15 as relayed by the stakeholder groups: the fisheries, the managers, the environmental organisation and the scientists. In the third part, we explore technological solutions and concepts we believe are in many ways indicative of the potential way forward. The fourth part relays other relevant considerations in relation to transition from a discard ban to full catch accountability. The fifth, crucial part is the NSAC advice on identified hurdles and measures to render future implementation of the landing obligation pragmatic and compliance effective, as supported, with consensus, by the NSAC members.

2 Alternative discard systems: Icelandic and Norwegian experience

2.1 Iceland

Iceland has used an Individual Transfer Quota (ITQ) system since 1991. The regulation on discarding has been in place since 1996. It stipulates that all catches must be retained and landed with possibilities for exceptions in releasing live catch under a specific length or weight or caught using certain types of fishing gear. Exceptions are also possible for fish of no economic value, entrails, heads, and other waste when processing on board. Exemptions are also in place for salmon, sharks, and some flatfish and rays.

The Icelandic management system encourages vessels to land everything they catch. It allows 15% of each vessel's catch quota to be transferred to the following fishing year, and 5% to be caught in excess of a vessel's catch quota, which is then deducted from next year's quota. Undersized fish are only partially (50%) withdrawn from catch quotas.

Alternatively, vessels may land up to 5% in excess of quota. The fish goes to market and 80% of the monetary value from the catch goes into a special development fund, while the remaining 20% goes back to the fishermen to cover the costs of bringing the catch to land.

¹ https://www.nsrac.org/latest-advice/?advice_search=landing+obligation&date=

There is a requirement for each vessel to catch at least 50% of its catch quota, while the remaining 50% can be bought and sold. This gives greater flexibility in the use of quota and an open market between businesses exists. There are no special rules on bycatch since, technically, there is no such thing as bycatch as everything needs to be landed.

Annual scientific recommendations on TACs are published in June, with consultations held in July. Catch quotas are then published in September and are valid for the ensuing year.

There is transparency, cooperation, and trust when it comes to landings in Iceland. Catches are weighed upon landing by certified weighers who operate independently of both the seller and the buyer. The quota is balanced for each vessel after each trip and open access, real-time information is available online on landed catch and quota status. Any infringements and sanctions are published publicly, thereby “naming and shaming” wrong doers. Fisheries administration have been shown to be transparent, efficient, and trustworthy, thus they are well regarded by fishers. This encourages stakeholders to cooperate with the authorities.

There is a market value for small fish in Iceland. The lower prices for smaller fish are compensated by meeting quota. Catches of undersized fish are deterred by establishing closed areas where juveniles are found in large numbers. The details of these closed areas are subsequently communicated via state radio on Channel 1, following the weather update. It is incredibly quick, with measures being implemented within 1 hour.

To encourage adherence to the regulation, the Directorate of Fisheries undertakes statistical analysis on discard risk by vessel. This risk analysis can help to identify discards or suspicious behaviour. Any vessel showing suspicious behaviour will need to pay for an on-board observer from the Directorate of Fisheries, thus leading to an increased cost for the vessel in question. The publication of the risk register has also been shown to deter illegal activity.

The Directorate of Fisheries and the Marine Research Institute Iceland (MRI) have collaborated on sampling for size related discards since 2001. The results indicate that discarding is at approximately 3-5% (data applies to cod fishery).

The use of drones for fisheries surveillance was legalised in Iceland in July 2022, though there was a big majority of fishermen who were against their use. Drones are used as an extension of traditional surveillance. Fishers are normally unaware of the drones, and the drones will only start filming if discarding is being observed. It was noted that the rules of use must consider issues regarding data protection and privacy. Data on drone surveillance is also due to be published to assist with enforcement.

Although the NSAC recognizes certain benefits of the Icelandic system and measures, we note that it is not necessarily directly applicable to the EU and its fisheries management system.

2.2 Norway

It is much more straightforward for countries like Norway to develop their own policies, as they are not bound by the complex EU fisheries legislation. The most significant difference between the LO and Norway's discard ban is that in Norway a small amount of each vessel's quota is removed before quotas are shared between vessels, in order to account for situations where a vessel under or overshoots its share. Where a vessel takes less than its share, it is permitted to harness extra capacity to top-up its quota by targeting other species, thereby switching fisheries. When a vessel goes above its quota, it can still land the excess fish, however, the government receives 80% of the money from the sale, while the vessel receives 20% to cover the likes of fuel costs. The scheme has been highly successful in Norway.

Norwegian fishing vessels also transmit live data to research institutions on a daily basis so that scientists can collect real-time information on the location of fish and fishing vessels. The system works well for both stocks and fishers.

Norway has never applied CCTV in fisheries. There is an offshore coastguard for enforcement purposes and it is allegedly rare for Norwegian fishers to disregard the rules including the discard ban, which have been developed together with the fishers to ensure legitimacy.

Although the NSAC recognizes certain benefits of the Norwegian system and measures, we note that it is not necessarily directly applicable to the EU and its fisheries management system. In addition, Norwegian fisheries are significantly less complex in terms of species targeted. Notwithstanding this, due to their similarity, it would be easier to mirror this system in Europe as opposed to the Icelandic one.

3 NSAC experience with Article 15 of the CFP

The NSAC workshop intended to capture the state of play and experience with Article 15 of the CFP was conducted in an interactive way. Below are collated observations gathered under a heading, depending on whether the observation was of *management/governance* nature, *technology and control*, or if it relates to *fisheries science*.

Management/governance

The EU system of fisheries regulations is extremely complex and often poses challenges as regards its implementation. The assumption that there are many ways in which Article 15 could be better implemented prompted a discussion on alternative ways and additional flexibilities allowed by the legal structure of the EU fisheries legislation. It was generally observed that Article 15, as it is currently implemented, is not fit for purpose. This does not preclude the landing obligation as an efficient measure for eliminating or reducing discards - with a more adaptive approach to its implementation, it could benefit both, the fishers and the fish stocks.

One of the main assumptions/observations shared by the participants was that the buy-in of the landing obligation by the fishers is low, contributing to a considerable lack of compliance. Currently there is also few incentives in place to promote compliance. It was highlighted that the governance should focus on positive (carrots) instead of negative (sticks) incentives, such as removal of technical rules related to selectivity, adaptation of control measures, quota top-ups conditional upon catch documentation (Article 16), preferential access to quota for more selective fisheries (Article 17). To this end, the use of EMFAF should be simplified and available for digitalisation of the fleet and any other supporting measures provided to the fishers faced with challenges posed by the landing obligation.

A particular approach was presented by the Icelandic authorities where detailed information on landings, infringements and sanctions applied to Icelandic fishers is published online, ensuring transparency and providing no reason to suspect unfair treatment. In this way the administration is shown to be transparent, efficient and trustworthy, which creates an incentive to cooperate and comply as lack of compliance results in public shaming. This approach was deemed interesting by some stakeholders, though it must be underlined that Icelandic system, society and fisheries management are distinct from that of the EU. In the EU this level of transparency would prove challenging due to GDPR provisions and in addition, the EU's structure would make it challenging to apply such a system on an EU level.

Participants observed that the EU fisheries management system is rather slow and not sufficiently agile, resulting in crucial delays in setting TACs. Moreover, the TACs often do not reflect the catch compositions due, partially, to this delay. A more-timely reaction is needed also in approving delegated acts for more selective gear. Here we would also like to recall Article 16.3 of the Framework regulation, which implies the use of in-year TAC setting in cases where there is significant disparity between the fishing opportunities and catch composition, which so far has never been practiced.

One of the conclusions shared by the Fisheries, Managers and NGO groups was that, the Landing Obligation is seen as a policy objective/target instead of a mean to this objective. In their view, the LO should be perceived as an instrument for minimizing unwanted fishing mortality by increased selective fishing methods. The measure itself requires a balance between improving selectivity and avoiding choke situations. There are also conflicts identified between the CFP/LO and other policy areas, such as the EU labour rights and even the EU Treaty.

Mixed fisheries are the ones facing significant challenges and often for them exemptions are a crucial tool for keeping the fleet viable in light of restricting stocks (discards generated through lack of quota or bycatch in targeted fisheries). However, dealing with exemptions is complex and time-consuming, and annual cycles are considered an issue as often they contribute to stakeholder fatigue. Clear rules and definitions, as well as continuity of derogations, are therefore essential for their implementation. Furthermore, it was observed that participation in pilot schemes for testing selective gear often risks losing an exemption, which directly discourages fishers from participating in such schemes. In addition, there is the sentiment in fisheries community that the landing obligation is a measure aimed towards further restricting demersal fisheries. The nature of pelagic fisheries is such that they manage

to avoid the majority of the challenges posed by the measure as their catch composition is more homogeneous.

Some suggested that the focus should be on selectivity rather than prescriptive mesh size determinants to allow fishers to reach the objectives rather than deal with restrictive means. To this end, a better use of the flexibility measures (intra-annual and intra-species flexibility) included in article 15 was recommended.

It was suggested, among others, that the TAC setting should take into account certain species that pose a choke risk.

It was further suggested that co-management and participatory schemes should be promoted in a more bottom-up approach to management. Best practices should be championed and their sharing facilitated.

There is a need for overcoming the independent policy-making and a silo mentality in setting biodiversity thresholds. Currently this is done without account for the other aspects of the ecosystems (fisheries, MPAs, land-based solutions etc.) Efforts should be made toward a holistic fisheries and biodiversity management (ecosystem-based approach to fisheries management).

Technology/control

Stakeholders observed that not all problems can be solved by improving selectivity and that more flexibility is needed in regulations as regards technological applications, including the right incentives to make optimal use of these systems. The stakeholder observed that the implementation of new gear to improve selectivity has proven a complicated and lengthy procedure, and without a guaranteed success that the gear will indeed be approved for use. This limits the flexibility around the use of innovative gears and consequently hampers innovation.

The NGO group identified the lack of control as significant impediment to the LO implementation. As a solution they proposed a risk-based Remote Electronic Monitoring (REM) implementation. In view of this, digitalisation of the fleet should be supported through easier access to EMFAF. In terms of control it was suggested by the fisheries group to implement a third party control at the landing.

Conversely, the fisheries representatives do not agree with a blanket approach to REM, in particular, as means of control and posit that it should be used on a voluntary basis subject to positive incentives, such as quota top-ups. However, it was suggested that the main priority for fishers is to be allowed/capable of utilizing existing quotas to the highest extent possible.

When discussing REM, there is still a question on the ownership of fisheries data, protection of privacy and access to data. Different approaches should be used in an event that the data is used for control. If used for scientific stock assessment and advice, it shall be used in a way that data strictly cannot be used for other purposes.

The fisheries managers believe that REM could be used as a tool for control but also to improve data collection. In this respect, REM could be implemented through an incentive of allowing more freedom for the industry to choose their most appropriate gear. Allowing fishers to contribute to improving data collection will contribute to a greater sense of ownership and responsibility. A better understanding of the stock will in turn contribute to the reduction in choke risk. In other words, through a 'free-enterprise' approach, accountability is transferred to the industry to contribute to the sound management of common resources, and in return they are granted liberty in how they approach the management.

In general, Fully Documented Fisheries (FDF) approach was supported, however it was underlined that this must be accompanied by positive incentives, such as permission to discard and free choice of gear. Furthermore, any risk of breach in data protection and privacy should be minimized. Early stakeholder participation including cooperation with Member States is paramount to a successful implementation of FDF. In terms of Artificial Intelligence (AI), the managers agreed that Automatic Catch Registration could be used for quota management and noted that there is no need to land all undersized fish but rather to leave it where it belongs – in the sea. Here it was emphasized that a level-playing field should be sought with the UK.

In terms of FDF, one identified challenge was maintaining high-technology devices at sea and the need for additional crew members. Furthermore, coordination between research institutes, the Member States and the industry should be facilitated. FDF ambassadors are important for buy-in and will contribute to widespread implementation. Finally, fishers expressed scepticism in processing observation through samples/individual trips/vessels as this can lead to misconceptions in cases where such samples are not representative. Instead, a holistic picture should be taken into account for fisheries management. It is still unclear if AI technology is advanced enough to bring this about. Further challenges were observed in extrapolation of weight from AI and computer imaging. There are also technical challenges observed in different ongoing projects across the world applied to different fisheries and it was noted that *one size does not fit all*. Moreover, it was suggested that the algorithms and protocols should be open to public.

Other technological solutions should be further explored, such as the trawl camera. The trawl camera is a camera placed on the bottom trawling gear thereby informing fishing decisions but also providing valuable data for stock assessments. This eliminates the privacy issues as no human actors can be seen in the footage. Nevertheless, the technology is currently still in development stage and is not yet ready for commercial use, although the development and commercialisation are advancing fast.

With regards to technology, more effort should be put in championing best practices. Engaged advocacy for policy and technological solutions should be strengthened and dissemination means enhanced. Cooperation with the fishers, is important to understand the challenges on the ground and sincerely support their efforts in implementation.

It was further observed that innovation projects for improving selectivity in some fisheries have so far produced few solutions even after extensive effort. It was noted that profit margins are

too small for experimental fisheries, offering little incentive to participate. In addition, the landing obligation is hampering participation in projects, as use of new gear might prevent fishers from using existing exemptions. Such negative influences should be minimized or eliminated to foster innovation.

Finally, it was highlighted that not all projects find their way to the managers, information is scattered and it does not always reach the target audience in a timely fashion. Improvements should be made in dissemination of information. One idea would be to develop a platform with a collection of registered ongoing and completed projects on fisheries technology.

Fisheries science

Concerning fisheries science, it was uniformly agreed that there is a need for sound scientific basis for exemptions, however it has proven challenging to obtain the relevant data (i.e. on survivability). One solution to improved stock data was to promote co-management and participatory schemes – cooperation with the industry for data provision. This would mean for fishers to take the ownership in the provision of scientific data by taking part in research and thereby contributing to sustainable management of common resources. In this sense, fishers' role in data collection and sharing of information should be promoted. Industry-science partnerships were highlighted as a good approach.

Stakeholders underlined the problematic of quotas not being in line with ICES advice (example was given for haddock). This jeopardises fishers' best intentions to fish sustainably by creating a choke risk, despite science showing a favourable status of the stock. Such discrepancies should be eliminated as early in the process as possible.

The scientists explained that there is an unavoidable time lag between data collection and the setting of the TACs. Furthermore, there is an issue with the quality of provided catch data. Low-quality data inevitably impacts the quality of scientific advice. Compromised advice translates to compromised management further hampering the achievement of MSY. It was agreed that the optimal and effective solution for assessing realistic state of marine resources would be real-time data collection through electronic logbooks.

Expressed was also the need for improved predictability of the work in STECF on data requirements for review of possible exemptions to the landing obligation and development of increased selectivity. In addition, multi-lateral coordination between research institutes and fisheries departments where exemption proposals concern a fleet from more than one country would greatly benefit their application.

4 Technological solutions

4.1 Fully Documented Fisheries

“Fully documented fisheries are not fit for human consumption and are doomed to fail without

the proper use of AI.” (Pim Visser at the NSAC Landing Obligation Workshop) Having analysed two best practice research projects spanning from 2013-2018, it was observed that the LO is not practical, compliant, nor enforceable in Dutch demersal fisheries.

It is generally felt that CCTV is presented as a panacea to the problems of the LO, but it is nevertheless controversial. Accurate registration of all catches is necessary, however, previous projects have concluded that good estimates are impossible using traditional methods. In this respect, the CCTV is a monitoring tool as opposed to a control tool, and it was noted that FDF do not have to be defined by camera control.

The Dutch FDF research programme was established by VisNed and Wageningen University during 2020-2022, and has since moved to the BluePortCentre Den Helder. Control authorities are not involved in the research, thus it is an example of industry-science collaboration. The programme was established on the basis that the LO is only workable through exemptions. However, it is thought that a reliable registration system that can operate at sea could provide an alternative means of reaching FDF.

Practical participation of the fleet has been essential for this research. Forward thinking skippers were keen to participate, but crews were afraid of privacy breaches and increased workload. Thus, fishers were compensated for their participation and given ownership of the data collected.

Cameras were installed on vessels with the capability to stream snapshot images of catches to scientists at Wageningen University, who would use this information for species identification and to extrapolate catch weights and other metrics.

Several iterations of electronic monitoring were trialed, including object tracking and deep learning, which proved to be 80% successful at recognising fish. In a mixed fishery beam trawl haul, the registration and identification of all species caught using the technology is up to 95% accurate. The project is currently conducting trials at sea to ensure the technology is robust and to explore species classification and weight registration. This should help to improve data acquisition and training, innovate new algorithms, and integrate 3D visualisation.

Several important considerations apply:

- participation and liaison with the fishing fleet is essential for operational results;
- large sample of images must be analysed;
- computer services must be well managed.

4.2 Artificial Intelligence

Managers are increasingly turning to advanced technological solutions to manage common resources in a way that reflects reality to the highest degree possible. One of such solutions is the use of Artificial Intelligence (AI), which aims to improve real-time data collection on catches by developing automatic catch registration technology that enables key metrics (e.g. species, weight, and size) to be measured once a fish has been caught. This technology

requires onboard handling, AI, and camera systems to be effective. “CatchScanner” and “CatchMonitor” are two such technologies – the former uses a laser to collect data on individual fish as they pass under a camera along a conveyor belt; the latter uses cameras to identify fish according to species-specific characteristics.

The concept involves using AI for species recognition. Over time, AI can learn to attribute images of individual fish to their species. It may require several hundreds of thousands of examples to make this association, which can be achieved by generating datasets with hundreds of thousands of images using digital twins of fish. There is an element of bias in AI because it learns what an individual teaches it. Therefore, thorough training of the system is needed before application to European fisheries at large is viable.

So far AI projects have attained up to 98% accuracy in identifying more than 20 demersal species. For similar species, such as lemon sole and common dab, the technology is less accurate. Limitations include the overlapping of fish on conveyor belts, which makes it more difficult to identify individual species, and the challenges of real-world conditions.

The data collected can be reported to fisheries managers and/or scientists in real-time to help inform quota status and real-time closures. The analysis also has the potential to inform marketing and technology.

It was concluded that AI holds promise for developing solutions in fisheries management. The question remains how to apply the solutions in a way that is compatible with the interests of industry, management, and fish stocks.

The use of AI was explored through EVERYFISH project presented at the NSAC Landing Obligation workshop. EVERYFISH is a Horizon Europe research project with 17 partners from 8 countries that commenced in January 2023 and will run to December 2026. The project’s objective is to contribute to the digital transition of catch monitoring in European fisheries. As EVERYFISH recognizes, early stakeholder engagement in all stages of technology development vitally contributes to its performance and legitimacy.

5 Other relevant considerations

Years of experience with the landing obligation have shown that the current management system constitutes a metaphorical Catch22: *“The landing obligation as it now appears is a system that has “neither a stick nor a carrot”. An effective implementation of a ban on discarding requires high levels of at-sea monitoring and effective control, and/or strong incentives to fish more selectively, neither of which currently apply.”* (Ulrich for EP Fisheries Committee)²

It is important for the legislators to take stock of the efficacy of the measure proposed in 2013 and consider whether all legal tools have been exploited to the degree ensuring a level of

² https://backend.orbit.dtu.dk/ws/portalfiles/portal/149273093/Publishers_version.pdf

compliance conducive to restored and healthy marine ecosystems. Discussion with stakeholders revealed that the landing obligation cannot and should not be perceived as an end in itself but rather a means to reach that end. Indeed, it became clear that the ban on discarding should be considered as a transitional measure to what is currently known as Fully Documented Fisheries. The transition from a “discard regime” to a regime of full accountability entails the following³:

- Need for precise advice – even under regime changes (climate change) – in order to obtain realistic MSY and to avoid catches in excess of available quotas (particularly in mixed fisheries). Management solutions such as quota substitution and year-to-year flexibility may absorb some uncertainties in advice.
- With the Landing Obligation fishers can no longer align catches with quotas through discarding and are expected to avoid unwanted catches or stop fishing. This requires freedom to fish according to their individual type of fishing and the circumstances at sea. However, regulations are per definition a horizontal “one size fits all” tool. An alternative would be permission for free choice of method and gear. For scientific substantiation please see Mortensen et al⁴.
- Flexibilities to establish a workable interface between fishing and the resource fished.
- Proper incentive mechanisms (for example, prohibiting under MCRS to be sold at best price incentivises discarding rather than avoiding such catches. This is also supported by research showing that fishing of species below MCRS is not always unsustainable and it depends on biological features, as well as the rate of exploitation of different stocks.⁵
- Quota transferability (ITQ, swaps, leasing, risk pools etc.)
- Need to accelerate knowledge, technology, and the practical use thereof.

Facilitation from civil society organizations may benefit the reform greatly. Philanthropic funding areas in support of the Landing Obligation was pointed out in a discussion paper on Guiding philanthropy in support of the CFP (Schou 2013).⁶

³ https://mogens-schou.weebly.com/uploads/1/2/8/7/12874033/cfp_barriers_and_opportunities_rev1.pdf

⁴ <https://bit.ly/3k1eZwC>

⁵ <https://www.iss-foundation.org/blog/2015/12/10/is-catching-immature-fish-truly-unsustainable/>

⁶ <https://www.ft.dk/samling/20131/almdel/FLF/bilag/99/1320097.pdf>

6 NSAC Advice

Following the above considerations, the NSAC advises the following:

1. Increased selectivity/reduced fishing mortality through free choice of gear and adaptability of gear type during fishing operations

The NSAC believes that increased selectivity and resulting reduction of fishing mortality could be better achieved through free choice of gear. As opposed to existing restrictive rules, this would play on personal accountability of the users/fishers, and result in greater buy-in of the management by the users. In addition, monitoring and control through REM could be applied in exchange for increased flexibility in regulations and/or the use of more selective gear.

2. Pilot schemes for selective gear

The NSAC advises that participation in pilot schemes for testing selective gear should not lead to fishers being excluded from an exemption, as this directly discourages fishers from participating in such schemes.

3. Framing of Fully Documented Fisheries

The NSAC advises to refrain from ambiguous framing whereby FDF is presented as a control measure and present FDF as part of contribution to scientific endeavours in restoration of depleted stocks and habitats. Furthermore, the NSAC invites the legislators to explore potential positive incentives such as the free choice of gear, permission for MSRC⁷ fish to be sold for consumption, discard fraction as a top-up to CCTV-monitored vessels, exemption from majority of controls, grant data ownership to fishers, and efforts in incorporating real-time data into scientific advice.

4. Other FDF considerations

The NSAC advises that:

- coordination between research institutes, the Member States and the industry is facilitated to foster FDF implementation.
- FDF ambassadors are important for buy-in and will contribute to widespread implementation.
- Instead of basing management decisions on sample data, a holistic picture should be taken into account for fisheries management. AI technology might hold the potential to bring this about.
- AI algorithms and protocols should be open to public.

5. Stakeholder engagement, co-management and participatory schemes to management and FDF

The NSAC recommends that co-management and participatory schemes should be promoted in a more bottom-up approach to fisheries management and particularly in data collection. Early stakeholder participation including cooperation with Member States is paramount to a successful implementation of FDF. Fishers' role in data collection and sharing of information should be promoted. Industry-science partnerships are considered a good approach.

6. Community of practice and one-stop-shop for fisheries technology

The NSAC advises that best practices should be championed and their sharing facilitated. Improvements should be made in dissemination of information. One idea would be to develop a platform with a collection of registered ongoing and completed projects on fisheries technology.

7. Landing of undersized fish

The NSAC notes that there is no economic or biological rationale to land all undersized fish and advises to rather to adopt a species-specific approach based on science.

8. Level-playing field with third countries

The NSAC recommends that a level-playing field is sought with the UK and Norway on all management aspects for shared stocks.

9. Longer-term mixed species MSY approach with ecosystem considerations

With regards to mixed-species MSY approach, the NSAC recommends that permitted/anticipated fisheries mortalities are built into the legal system and accounted for in TACs and quotas. Furthermore, a longer-term approach to MSY is proposed with the inclusion of ecosystem considerations.

10. Adaptability and matching fishing opportunities with timely stock assessments; real-time stock assessments

In the longer term, it is vital that fishing opportunities are matching, as much as possible, the stock assessments, which should be timely. In the future, managers should strive for real-time data provision fostering real-time stock assessments and adaptive management.

11. TAC setting

The NSAC advises that the TAC setting should take into account restrictive species that pose a choke risk.

12. Establishment and use of flexibilities to the benefit of the LO implementation and compliance

The Commission should facilitate the use of existing and establishment of additional flexibilities, such as year to year flexibility, to the benefit of the implementation and compliance with the Landing Obligation.

13. Differentiated approach to the Landing Obligation and pragmatism

The NSAC advises that a case-by-case analysis be conducted, indicating where the LO is indeed beneficial, where it has counterindications and where it is irrelevant. This should further avoid misconceptions of one-size-fits-all approach and allow for a tailor-made approach to substantiated fisheries management and ensure a greater buy-in by the fishers. Pragmatism in setting restrictions is paramount.

14. Impact assessment of the Landing Obligation

The NSAC calls for an impact assessment of the efficacy and effectiveness of the landing obligation. In addition, the NSAC would like to understand how this can be measured within the current framework – is there a baseline against which landing obligation's effectiveness in achieving its goals could be measured? In view of this, the NSAC advises to move the focus from assessing compliance to evaluating the measure's aptness to achieve what it was set to achieve. The same is true for any other alternative measure.

15. The Landing Obligation as a transitional measure

The NSAC discussions made it rather clear that the landing obligation was implemented for the lack of a better management system providing an accurate overview of onboard operations. Fully Documented Fisheries represent one step further towards realistic, pragmatic and adaptive management. In view of this, the NSAC understands the landing obligation as a transitional measure until technological, legislative and technical readiness for a fully-fledged and operational FDF concept.