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A Template for the Development of Plans to Recover Overfished Stocks

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Overfishing results in valuable fishery resources being depleted to low abundance levels, with remaining fish of smaller size and often with a reduce range of distribution. This means the yield to the fishing industry is decreasing and the product available to the public is much less than might be available if more responsible practices were followed. In addition, commercially valuable fish stocks do not exist in isolation from the ecosystem in which they live. The act of fishing itself, if not well managed, can have long lasting effects on other components of the ecosystem through habitat damage, loss of non-target species and alteration of ecological balances. Overfishing and depletion of one or a group of species affects everything else in the system, changing the relationships among species, and associated habitat and consequently the productivity of the system as a whole in ways that are often unpredictable. Unfortunately, overfishing of principle resources is all too common through out the world and in EU waters.

To end overfishing, the rate of harvest, the fraction of the stock removed or discarded by fishing over the year, must be reduced to allow the stock to rebuild. The abundance of a fish stock changes due to gains through productivity, growth and reproduction, and losses through mortality (assuming immigration and emigration are negligible). So the rate of loss must be less than that of gain if the stock is to rebuild. Managers can control the rate of loss. Obviously, the lower the rate of loss due to fishing (harvest rate), the better chance there will be of recovery because more of whatever productivity does occur will go to rebuilding the resource. Similarly, if habitat is being disturbed or damaged by fishing, the greater the reduction in fishing pressure, the more likely it is that productivity will improve to bolster rebuilding.

Fishery resources usually have the potential to be rebuilt if appropriate steps are taken to end overfishing, allow stocks to recover, and then ensure that overfishing does not recur. Rebuilding plans work better if implemented quickly. They must be comprehensive in space, time and multi-species. A plan must result in a fundamental change in the way the fishery is operated and managed in the future such that overfishing does not simply begin again after some or all of the rebuilding occurs.

Monitoring and enforcement plans are needed for a sustained recovery plan. The biology of fisheries resources is inherently uncertain due to environmental variation, the difficulty of control and enforcement as well as uncertainty in scientific projections of the future exact trajectory of resources as management measures change. A recovery plan must be updated regularly as data are evaluated to ensure that rebuilding is truly occurring. This means, in effect, that recovery plans need to be multi-annual. Further, a clear set of indicators of stock status should be included as part of the plan. Some of the indicators should relate to fishing mortality rates, to ensure that overfishing does not recur, and should be derived from a stock assessment. Alternatively, simple indicators of exploitation derived from relative abundance and size composition data may be used. Other indicators should relate to stock abundance levels to ensure that recovery is, in fact, proceeding. Again, assessment information, relative abundance or other survey information should be used. In all cases, indicators of stock status must be related to clear reference points. Biological reference points for fisheries are very well developed in the ICES and other scientific forum. Exhaustive assessment information is not needed to employ clear reference points for exploited species.

In order to ensure that the factors that lead to overfishing do not recur, the structure and nature of the fishery needs to change as part of the rebuilding process. These changes should include reduction in the capitalization of the fishery the number of vessels potentially or actually engaged in that fishery.

Where recovery plans or national emergency measures are introduced compensation may be granted. These measures offers significant opportunities to support the implementation of EU recovery plans, alongside other measures to pay for technical adjustments, capacity reductions, management planning, training, etc.

Time Pressure

In the debate over fishery restrictions it is often stated that overfishing occurs over many years and can only be ended over many years. It is true that fishing pressure may take a long time to develop and build up to rates that deplete the resource, though there are also examples of very rapid increases in fishing due to market changes or new discoveries of gear or resources. It is also true that rebuilding may take a long time particularly for certain types of fishery resources or bycatch species that have very low rates of growth and reproduction. Sharks, for example, are likely to have slow recovery from depletion. In general, reducing the harvest rate quickly improves the chances of recovery of resources and the rate of recovery. This is because the longer fishing at higher rates continues, the more the stock is depleted and therefore the longer it will take to recover. In fact, recovery itself may be jeopardized if there are excessive delays in ending overfishing. For some stocks, if they are driven to low enough levels before fishing pressure is removed, they may be unable to recover to former biomass levels in the foreseeable future. Even for stocks with relatively high rates of production, if fishing mortality is only slowly reduced, the time needed for rebuilding may be disproportionately extended because production is dependent upon stock abundance to some degree in the first place. The longer the delay before reducing fishing pressure, and the slower the actual reduction occurs, then the more severe the reductions in fishing in either quota or effort will be needed. Consequently, there is substantial time pressure to make reductions in fishing swiftly and to take as large a reduction as practicable as soon as possible, rather than a slowly phased in reductions in fishing.

Unfortunately, economic, social and hence political pressures act in opposite to the need to reduce fishing quickly. Even though it is easy to show that slow reductions mean much greater reductions in the end, and usually even greater negative economic impacts, the tendency to try to slowly phase in reductions remains. Whenever possible, management actions that promote recovery should be taken quickly to preserve the remaining resource and increase the chance of a rapid recovery of overfished stocks.

Comprehensive Measures

Rebuilding plans must contain comprehensive measures and address all sources of fishing mortality including landings as well as discards. Bycatch and discard mortality have often been very high for some stocks that are ostensibly under a rebuilding plan. Bycatch reduction methods, direct controls on the fleets that have substantial bycatch and intensive monitoring of bycatch and discards through observer programs are essential, as bycatch and discard can undermine efforts to control the targeted fishery and therefore undermine rebuilding. Similarly, mis-reported, illegal and unlicensed fishing must be curtailed as far as possible. A goal of more complete reporting and monitoring should be explicitly included in the plan. All catches must be accounted including discards and landed catch as well as landed bycatch in other fisheries. The timeliness of reporting is critical in determining if a recovery plan is effective. The goal should be real-time reporting and immediate availability of data for evaluation. Similarly, data on fishing effort and the spatial distribution of fishing needs to obtained in real-time.

Overfishing should be ended over the range of the stock, such that protections are not just for one sub-stock or area. If only a small fraction of the range is protected while other portions or sub-stocks continue to be overfished then the chances of improved productivity may be reduced. This is because distributing the stock over a wide range often can buffer poor conditions in one area that reduce productivity in any one year. This is not to say that all protections must be equal in all areas, but that controls should reduce fishing effort throughout the range.

Overfishing almost inevitably affects several species, both those that are commercially important and other species that are bycatch to those fisheries. It also usually affects smaller fish of the commercially valuable stocks through bycatch. In order for rebuilding plans to be effective, then they must include protections for smaller fish subject to bycatch and commercially less valuable species that are associated with the target species. Otherwise, mortality on young fish can continue to have an enormously detrimental effect, and ecosystem changes can undermine rebuilding by changing the balance between species.

The decision on whether to implement recovery measures for a specific set of stocks or fisheries should not depend upon the completeness of the assessment information available for those stocks. Overfishing certainly occurs on resources where full stock assessments are not available due to a lack of data and the losses of those resources can be every bit as damaging to future sustainable fisheries as from those with complete stock assessment information. In many if not most cases, there is sufficient information on relative abundance, reduced size composition and other indications of overfishing to warrant reductions in fishing mortality even if a full assessment is unavailable. For example, for longer-lived species such as cod, plaice or hake a very truncated size composition, with only a small percentage of the fish above the age at full recruitment, is a clear indication of overfishing even if the overall abundance of the stock is unknown. Even such limited information can guide the implementation of rebuilding measures as well as serve as a basis for monitoring the progress of a recovery plan. In the simple example described above, a recovery plan should include increases in mesh or other measures that increase the age at full recruitment. In addition, a reduction in overall fishing mortality such that more fish are living to the older ages. Size composition can continue to be an indicator of whether the recovery plan is inducing rebuilding, even while more comprehensive assessment information is being developed.

Waiting for complete information or a full stock assessment can only damage the stock and make recovery more difficult. Taking quick action based on initial information or relative indicators of overfishing may mitigate the need for more drastic actions later with accompanying greater economic and social costs.

Habitat protections are an important component of a comprehensive rebuilding plan. Fishing gear can physically alter habitat in substantial ways. This is easiest to see with heavy mobile gears such as bottom trawls. However, it is also true that other gear types such as gillnets have habitat impacts. Since productivity of the resource is an essential part of stock rebuilding, reducing disturbance or loss of habitat may directly relate to the rate of recovery.

Most fisheries have not been operating in a manner that provides long-term habitat protections. Measures need to be included in the long-term plan for the fishery in order to maintain productivity for a rebuilt stock both during rebuilding and after. Long-term habitat protection can result from the use of environmental friendly fishing gear or the creation of closed areas.

Specific Management Measures for Recovery

To address the needs described above, specific management measures for rebuilding plans are needed. Of course many of these management measures need to be tailored for a specific fishery depending on the species caught including the discarded species, the types of gear used, the habitat types and other features. However, there are types of measures that are needed as components of most if not all recovery plans. In this section, these types of measures are briefly described.

Limited access and capacity reduction programmes in directed and associated fisheries are needed. In some cases, a limit access system may already be in place, but if overfishing and resource depletion has occurred then clearly overcapacity is a problem. Then, the limited access system should be strengthened to ensure that entry is tightly controlled, so the impact on the resources is reduced. Capacity reduction can take several forms, but it should be recognized that more than just the number of boats needs to be controlled. Measures that control increases in fishing power are also needed. Upgrading restrictions must be clear and well enforced so that fishing businesses know the conditions they must work with.

Rapid reductions in fishing mortality rates to as low a level as possible through a combination of quota or effort controls and closed areas are a key ingredient of any recovery plan. If fishing mortality rates are not reduced and held at low levels a sustained recovery will not occur. It is essential that major reductions in fishing mortality occur even if the final recovery targets are still uncertain. That is, once the need for stock rebuilding is clear then steps to reduce fishing pressure should be taken even if further adjustments are needed later. This is, in essence, applying a precautionary approach such that measures are not delayed due to uncertainty in the final scientific advice. It is almost invariably the case that more than one species has been impacted by overfishing and, therefore, fishing pressure needs to be reduced on several stocks at once. Managers should very carefully guard against restricting the fishery for only a few of the target species and allowing the others as well as non-target species to be further depleted due to overfishing. Even if the level of information available for each species is not equivalent, clearly similar species subject to the same fishing gears are likely to be overfished in concert, and therefore all will need protection not just those where the best scientific information is available.

Recent studies indicate the combination of quotas and closed areas or effort controls and closed areas is much more robust to uncertainty and therefore more likely to result in rebuilding compared to any one type of fishery control measure. This is because the closed area provides insurance against mis-estimation of the quota or other uncertainties such as illegal catches or excessive bycatch. In order for this positive effect to be realized the closed area must be large enough to protect a significant portion of the stocks of the species in need of rebuilding, should be closed to all fishing capable of impacting the depleted species, and be strictly enforced. Note that enforcement is a matter of fairness to those fishermen working within the rules as well as critical to protecting the resource.

Closed areas also provide critical habitat protections. These can be an important component of sustained recovery. In order for habitat protections to be effective closures must be year-round and maintained for the long-term. They need to cover principle areas of fish concentration, such as nursery areas or spawning areas, which are likely to be principle-fishing grounds. Particular attention should be paid to protecting concentrations of juveniles, or pre-recruits as they will be the basis for recovery, but this is not to say that reducing fishing mortality rates on mature fish can be neglected. All gear types capable of modifying the habitat as well as catching the species of concern need to be restricted.

Bycatch and discard reduction, through the use of bycatch reduction devices, closed areas and intensive observer monitoring of catches are essential to recovery. Observers should cover the entire fishery, not just the vessels that target the most depleted species. Observer data must be made available in real-time for scientific analysis as well as for accounting for the catch. All catch must be counted against the quota, not just the landed catch. In some cases it is most effective to implement a ban on discard to ensure control.

When a recovery plan is implemented, fishing fleets naturally seek to adjust to the restrictions to maintain income. This may result in a shifting of effort away from directed fishing for species that are the focus of the new restrictions to alternative, less restricted fisheries. If the alternative fisheries have a bycatch of the depleted stocks then the recovery will be undermined. Furthermore, those vessels that are unable to switch (often smaller vessels) may be penalized because not only are they greatly restricted, but without recovery their future prospects are undermined.

A comprehensive monitoring program as part of a recovery plan is essential. For as many species as possible an assessment of fishing mortality rates and abundance is needed to monitor recovery, though relative rates and levels can be used in cases where full assessment information is not available. It is important to establish biological reference points for the stocks under recovery. Note, however, that in many cases reference points can be established by analogy with other stocks or from simple biological data to provide precautionary indices of the progress of recovery. This may include consideration of size composition, relative abundance preferably from research surveys, though commercial catch rate data can be used with caution, and distribution information. Of course a full stock assessment is desirable for as many species as possible such that comparison with target and limit fishing mortality rates and stock abundance references points is possible.

Fishing mortality should be monitored to ensure that overfishing has in fact ended (i.e. the rate of mortality is well below the level that will continue to deplete the stock) and is not recurring. Abundance must be monitored to ensure that stocks are rebuilding toward safe biological limits, that is, that the depleted stock is recovering. Again, even if full information is not available for all stocks, simple measures of the progress of recovery can be used.

Finally, monitoring data must be used to update the recovery plan measures on a regular basis and adjusted accordingly. Managers should be very cautious about adjusting measures in response to apparent or early signs of recovery. For example, if a strong year class of one species appears available to the fishery strong measures should remain in place to allow that year class to grow and reproduce hence furthering rebuilding. There is a tendency to allow immediate increases in fishing to alleviate pressure on the fishing industry. But such relaxation of the controls will only delay or undermine recovery and therefore result in greater loss of benefits. Similarly, if the stocks are not responding to management efforts then greater protections need to be put in place as quickly as possible. This means that data on the resources must be fully available and analyzed regularly in order to ensure that adaptive management measures can be taken.

For the last several decades, overfishing of vital living marine resources has been all too common. In this decade, recovery plans need to dominate the management of the oceans. The principles needed for recovery are straightforward, though the political difficulties are formidable. But the fisheries resources will be lost if action is not taken soon to implement real and comprehensive fishery recovery plans.

Plaice (sole) recovery plan

North Sea plaice is taken mainly in a mixed flatfish fishery by beam trawlers in the southern and south-eastern North Sea. Directed fisheries are also carried out with seine and gill net, and by beam trawlers in the central North Sea (ICES Area IVc). In the mixed beam trawl fishery, the exploitation of sole and plaice are closely connected. The minimum (stretched) mesh size for the sole fishery is 80 mm, while for the plaice fishery this is 100 mm. Hence, in the mixed flatfish fishery, this results in substantive discards of undersized plaice; in the southern North Sea up to 80% of all plaice caught are discarded. The survival rate of these discarded fish is near zero. The minimum landing sizes for plaice and sole are 27cm and 24 cm. Survey shows that both species are discarded above their minimum landing sizes (plaice up to 29cm and sole 24cm). In the southern North Sea up to 80% of all plaice caught are discarded. Measures to reduce discarding in the mixed beam trawl fishery would greatly benefit the plaice stock and future yields.

Fleets exploiting North Sea plaice have generally decreased in number of vessels in the last 10 years, partly due to the MAGP policy, although re-flagging vessels to other countries has compensated for these reductions.

The spawning stock of plaice is estimated to be near the lowest observed level historically. Landings have decreased since 1990 and were 70 000 t in 2002. Fishing mortality has decreased but remains too high, that is, above the level recommended by ICES. At its present exploitation rate there is a high probability that the stock will remain below the levels observed in the 1970s and 1980s and below safe biological limits. The abundant 1996 year-class was expected to increase the spawning stock, but a slower growth of this year class and high discarding has reduced its contribution to the spawning stock.

One of the important features to note in the plaice stocks is that there are very few older age groups in the most recent years. This is evidence of a stock under excessive fishing pressure. Almost the entire stock of plaice in 2002 is composed of 0 and 1 year old fish (juvenile year classes). The stock can not rebuild if fish do not live to the older ages. In addition to the increase in spawning stock biomass, recruitment will be improved when more females live to an older age; there is good evidence that spawning success increases with age in addition to just the increase in spawning biomass.

Objective of the recovery plan

The recovery plan aims to rebuild the spawning stock of plaice in the North Sea to a level in excess of 300 000 t in accordance with ICES advice within a time frame of five to ten years.

Fishing effort limitation

In order to effectively rebuild and protect plaice and sole stocks and reduce discards, fishing effort and mortality must be decreased in all North Sea flatfish fisheries. Plaice is harvested outside safe biological limit and fishing mortality rates have reached the highest recorded values in recent years. This, and the poor performance of TACs in reducing fishing mortality in mixed species fisheries, leads to the conclusion that the required reductions can only be achieved if significant reductions in fishing effort are included in management, and effective deterrents to discarding are implemented. Extensive discarding occurs, largely of small and juvenile fish, which result in foregone potential yield. In addition, for stocks where virtually all of the remaining biomass is in the one or two youngest year classes, reductions in discarding may be the most effective strategy to start rebuilding stocks. If discarding is not reduced then it is unlikely that the rebuilding plan will be successful.

To achieve the objective of the recovery plan, effort reduction of the order of 60% for the beam trawl fishery for sole and plaice in the North Sea is needed. This reduction in effort should occur immediately in order to protect the remaining stock and begin the rebuilding process. Changes in the effort reduction scheme can only be allowed if the stock is recovering faster than expected.

Total Allowable Catches (TACs)

The needs of the plaice recovery plan should, in theory, be met most directly by simply setting the TACs for all species in mixed fisheries to correspond to the fishing mortality rate intended for plaice. Therefore the TAC for plaice and sole should be set at a precautionary level inclusive of the discards of these species. Incompatible TACs between plaice and sole may result in increased discarding. However, as plaice catches are usually higher than sole catches due to the 80 mm mesh size set for sole. Plaice is consequently discarded because the sole quota is not filled. Therefore fishermen tend only to retain the larger plaice. Reduction in effort coupled with reduced and combined TACs inclusive of the bycatch will therefore be more effective in reducing fishing mortality for both species.

The use of bycatch reduction devices to reduce discard of plaice and sole

Given the lack of comprehensive data on the real quantities of discards, the true fishing mortality rates exerted on stocks, especially on young fish, are uncertain. However, even in the absence of comprehensive data, the age composition of the remaining stock of plaice is clear evidence of excessive fishing mortality on the younger age groups. This has a number of repercussions, especially for the evaluation of measures intended to improve selectivity in order to reduce catches of young fish.

The following projects should be initiated to reduce discard in the mixed species fishery.
To reduce the level of discard in the plaice and sole fishery it is recommended that a pilot project is initiated for the Dutch, Belgium and UK beam trawl fishery. This project would have three components; one would be to establish a monitoring program with extensive observer coverage to improve the estimates of discard of all

species in the fishery including turbot, skates and rays. The second would be to experiment with new technologies and a third would be to initiate a discard ban in the fishery to directly reduce the amount of unwanted and non-target species that are caught in the fishery.

The monitoring of discards will give fisheries managers the possibility to determine the unacceptable levels of discard. This could then be used to close a fishery if a given percentage of the catch contains undersized fish. ('real time closures', i.e. local closures put in place rapidly in response to reports or catches of excessive amounts of juveniles).

Minimum landing size (MLS)/mesh size
Plaice and sole are taken in a mixed species fishery where both species are subject to MLS. A reduction of discard may be achievable if the MLS is changed to address the complexity of the mixed species fishery. MLS should be above the size of first maturity of females, 30-32cm for plaice, to allow a reasonable probability of one or two spawnings before the fish are fully vulnerable to the fishery. For plaice the MLS should be set at 34-36 cmto account for these factors. Optimal mesh sizes are 145mm for plaice and 84mm for sole. Only with the use of selective gear will the fishery be able to reduce the discard of plaice.

Selective gear
The exploitation rate for each species is determined by the design of the gear used to fish it as well as the effort exerted on the stock. Since plaice is caught in mixed fisheries, unnecessary mortality may result due to bycatch even after the directed fishery quotas run out. If species can be separated during trawling before the catch is brought on board, mortality may be reduced. Furthermore on-going research has shown that gear design may be modified to separate species during trawling.

Trials with different designs of release panels should be initiated and continued for commercial beam trawlers in the North Sea using a combination of catch comparison and selectivity techniques. Experimental trials of aluminium grids with a bar spacing of 25 mm in the trawl fishery, which will allow juvenile plaice to escape should be pursues as a possible bycatch reduction tool. This measure will also reduce the bycatch of cod, which isunder a recovery plan. There have been successful trials with large mesh sized top panels in the beam trawl fishery and mandated use of such panels should be implemented. Furthermore trials are needed to evaluate the selectivity for plaice, sole and also cod using square mesh and diamond mesh. Other bycatch reduction devices such as (large) escape openings in the top panel of these nets have been successful, depending on the type of gear (tickler chain or chain matrix), and the size of the gear in relation to the extent of the release panel, particularly the length. Further research is needed to find the optimum mesh size, and panel length, particularly for uneven grounds and to explore the possibilities of a lower headline attachment, a square mesh codend or a square mesh window.

Incentives

Where EU recovery plans are introduced or where Commission or national emergency measures are adopted, compensation can be granted for one year, with the possibility of an extension for another year. Compensation can also be granted where EU legislation imposes technical restrictions on the use of certain gear or fishing methods. This measure offers significant opportunities to support the implementation of EU recovery plans, alongside other measures to pay for technical adjustments, capacity reductions, management planning, training, etc.

Incentives should be provided to encourage the use of alternative fishing gear with the aim of improving selectivity and reducing the level of discards and benthic habitat destruction. Therefore higher quotas for stocks that are not classified by ICES to be harvested outside safe biological levels should be allocated to fishermen who choose to alter their fishing methods to techniques that are more selective and have a very low or no impact on the benthic habitat e.g. Danish seine.

Monitoring, inspection and surveillance

Any recovery measures are in need of improved monitoring, inspection and control for vessels affected by the management system. Underreporting and discard are considered the factors most likely to undermine any recovery plan and therefore these two issues need to be addressed. Observers should be allocated to vessels to collect data on other elements of the fishery including catch composition (target and non target), levels of discards and habitat destruction.

Closed areas

Closure of the Plaice box to all fishing vessels on a year-round basis would benefit the plaice stock, as the present limited closure still results in juvenile plaice being discarded by a significant amount of vessels that are allowed to fish within the box. The plaice box is open all year for vessels under 300 Hp. Such a total closure would potentially also lead to increased recruitment rates in sole, which also suffer from high levels of discard. The aim of the restrictions applicable in the 'Plaice Box' (38 000 km2/ in place since 1989, but only fully closed for large trawlers since 1996), is to reduce discards of undersized commercial demersal species such as plaice and sole on their main nursery grounds. However, the failure to meet the predicted levels of recruitment, has lead to the reduced benefits of the closure.

Spawning areas should be established as closed areas (December/March) in the southern North Sea. Given the low level of biomass in the stock at present, protection of concentrations of plaice should be given a high priority. There has been very extensive research on plaice over many years. It should be possible to approximate a spawning closure and refine its boundaries, as more information becomes available.

Overall, recovery measures reducing fishing effort, minimizing bycatch particularly of small plaice, and protecting spawning concentrations are essential to rebuild the plaice resource in the North Sea. These measures should become effective immediately, thereby avoiding a long phase- in period. As the stock begins to respond, increases in fishing effort should be very carefully controlled until a clear SSB well above precautionary levels has been established, so that recovery is not undermined. Monitoring programs and evaluation with respect to biological reference points and ecological indicators must be included as part of the recovery plan.

Spurdog recovery plan

Squalus acanthias (spurdog) is distributed worldwide occurring throughout the ICES area, and also widespread in the NW Atlantic, Pacific and other major oceans. Evidence from tagging information indicates that there is one stock in the NE Atlantic, as the number of transatlantic migrations that have been documented is extremely low in relation to the number of fish tagged. It is one of the better-studied elasmobranchs, but there are still some significant gaps in the knowledge of the biology and ecology of the species. Several studies have examined age and growth, but there is no information on the age-structure of commercially landed fish. The ability to convert length data to age data is hampered by the slow growth rate of the species, with larger individuals possibly in the range of 20-40 years. Improved knowledge of age and growth, and the age composition of commercially landed fishes will improve age-based assessment methods and demographic models.

Spurdog is a relatively small (<130 cm TL) squaliform shark and by far the most important of the directed fisheries for elasmobranchs. This species is the most widespread of the coastal elasmobranch species in the NE Atlantic, moving in large packs, often segregated by size and sex. The population exhibits low reproductive output and a low intrinsic population growth rate. It is classified by FAO as having the lowest population growth rates calculated for any shark species and life history data indicates that spurdog falls into FAO's lowest productivity category.

France, United Kingdom, Norway and Ireland all take spurdog in directed fisheries that operate locally and seasonally and as an important utilised by-catch in otter trawls and seines where the target species are generally whitefish. Preliminary assessment (carried out under the DELASS project) suggest that the stock is seriously depleted and may be as low as 2 - 9% of virgin biomass.

Spurdog has been exploited throughout the 20th Century in the ICES area. A major expansion of the fisheries occurred during the 1950's and 1960's, with peak landings approximately 58,000 tonnes during this time. Landings declined in the late 1980's, and annual landings in recent years have been of the order of approximately 15,000 tonnes. Bycatch of spurdog is significant in trawl fisheries for roundfish and flatfish and tangle net fisheries for sole and other flatfish during spring and summer in the North Sea. Current levels of harvest are excessive, and have reduced these populations to levels at which their survival may be threatened by other factors and exceeds that which can be sustained.

The UK is one of the major fishing nations for spurdog, and this species is taken as by-catch in a variety of mixed fisheries. It is also targeted by long-line fisheries and, in inshore waters, gillnet fisheries may target seasonal aggregations. Data on landings and effort have been collected for UK vessels (excluding small inshore vessels) for the period 1982-2002, and for ICES subarea IV (North Sea), ICES Division VI a (NW Scotland), and the Irish Sea, Celtic Sea, Bristol Channel and western English Channel (ICES divisions VIIa, e, f, g, h and j). Landings per unit effort (LPUE) have been examined for the major trawl gears landings spurdog, including heavy and light otter trawls, unspecified otter trawl, bottom pair trawl, midwater demersal trawl and midwater trawl.

North Sea (ICES Subarea IV): LPUE for spurdog caught by bottom trawlers have declined from more than 6kg/hr in the early 1980's to 1.5-3.5kg/hr in the years 1999-2002. Although the overall trend indicated a decline, there was an increase in LPUE between 1994 and 1998, with LPUE increasing to more than 10 kg/hr in 1998. This increase is likely due to improved targeting on spurdog and is very unlikely to reflect population increases.

NW Scotland (ICES Subarea VI a): Data from trawlers indicated that LPUE decreased during the mid to late 1980's, with a general increase in LPUE since 1989. Also, the level of LPUE in this area (4-23kg/hr) was typically higher than in the North Sea (1.5-10kg/hr).

Celtic Seas (ICES Divisions VIIa,e,f,g,h,j): Landings in the Irish Sea, Bristol Channel, Celtic Sea and western English Channel comprise a significant component of total spurdog landings. LPUE from trawl fisheries showed a broadly similar pattern to that observed in NW Scotland, with a gradual decline in the 1980's.

Objective of the recovery plan

The recovery plan aims to rebuild the spurdog population in the Northeast Atlantic and the North Sea. Until more information on population levels is obtained, the recovery plan will use a target fishing mortality rate of not more than 0.1 and a target relative biomass similar to that estimated in the 1970's.

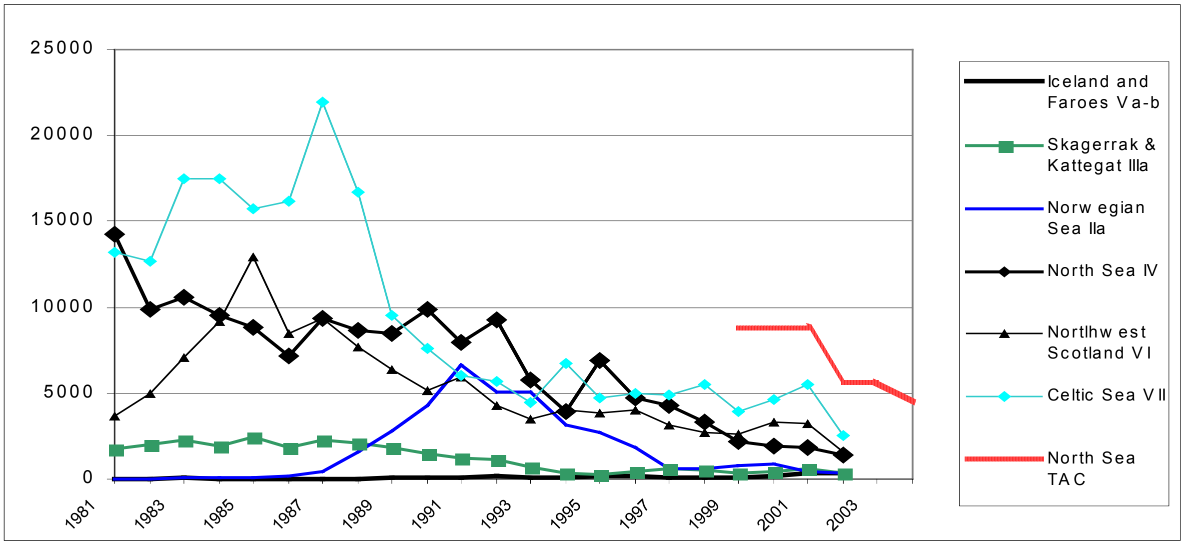
The target fishing mortality rate of 0.1 is a precautionary target given the low productivity rates for shark populations generally. It should be noted that even this harvest rate may well be shown to be too high as more biological information on the stocks is obtained. The relative biomass level should also be view as a precautionary target to try to reverse the apparent decline in the stocks that has occurred over the last two decades.

Total Allowable Catches (TACs)

Catches for spurdog have been unsustainable for several decades and the 'precautionary' quotas set have not addressed this problem. The EC quota for spurdog in the North Sea was set at 7,100 tonnes in 2002 and reduced to 5,640 tonnes in 2003. This reduction did not reflect landings in 2002 by UK, which was less than half of the allocated quota of 4,564 tonnes in 2003. The EC quota for 2004 has been set at 4,472 tonnes a reduction of 21% and the UK allocated quota is 3,618 tonnes, The "precautionary" quotas have not been set with the objective of delivering specific stock management objectives for spurdog, rather with the objective of managing fishing activities. These quotas are based solely on levels of former unmanaged and unsustainable catches, not through a process of stock assessment. The quotas do not take into account the uncertainty due to misreporting or discarded bycatch, and are not at present used as a tool for delivering sustainable fisheries.

It is essential that in applying precautionary quotas that estimates or actual measurements of discarded bycatch are taken account of when setting the quota. Precautionary quotas would then be established in the sense of restricting catches to more precautionary levels (i.e. lower) than would be undertaken in the absence of quotas in an effort to reduce current unsustainable levels of catch. In the North Sea, on current estimates this would require a reduction in the TAC of 80% to reflect recent low catches.

North Sea TAC and Spurdog landings in ICES Areas, 1981-2002.



(Landings in 2003 not yet available. 2004 TAC is the European Commission's provisional recommendation).

Reduce bycatch

Given the lack of comprehensive data on the real quantities of discards, the true fishing mortality rates exerted on stocks is unknown, but clearly no directed fishing for spurdog should be allowed unless the bycatch can be substantially reduced, as the pattern in landings shows that the stock can not sustain the current high level of fishing mortality. . There is no information on trawl selectivity for shelf-dwelling sharks or dogfish. However demersal trawls are not very effective at targeting fast-swimming species such as spurdog, which is consequently only usually caught as by-catch in such gear. It is therefore believed that mature females are less vulnerable to this gear. It may be possible to reduce this bycatch by modifying the gear to induce the escape response for spurdog more quickly. Bycatch reduction methods should be strongly encouraged for the fisheries that currently have some bycatch of spurdog and other small sharks. The incentive for bycatch reduction could be related to access to certain fishing grounds (e.g., access is only allowed if bycatch reduction devices are used) or assistance in experimental gear development.

Member States discard sampling programs may provide information on discard rates of spurdog within regional seas and provide information on nursery grounds. High discard rates of juveniles will have an negative effect on the population and needs to be addressed. In areas where discard data are shown to be high, mitigation should be implemented through the introduction of closed seasons or bycatch reduction devices should be introduced to reduce discard of juveniles.

Selective gear
Mesh-size regulations can be a very effective means of regulating gill net fisheries. For the directed spurdog fishery, a maximum mesh size could be particularly useful to protect the spawning stock because of the difference in size between the two sexes and the need to protect the large female spurdog. Allometric data can be used to determine the optimum maximum mesh size for such fisheries. Tangle nets mesh size and hanging ratio could be the subject of regulation, because these gears may not discriminate very well on the basis of size.

Measures could also include restrictions in the number of hooks, soak time, gillnet length, or hours trawled. Effort limitation may reduce both directed catch and discard if appropriately applied. As more information is collected, effort limits should continue to be fine-tuned based on quantitative relationships between effort and fishing mortality.

Maximum landing size
Maximum landing size for females is an important management measure for spurdog, as the targeted stock is known to include a significant quantity of the larger, mature female sharks. This action could afford protection to the mature females. Also a minimum landing size could protect juveniles. Data to frame such measures (maximum length) is available for spurdog from literature sources. Using a maximum and minimum landing size can effectively reduce the mortality on the population as a whole and help maintain better economic returns from landings. Note however, that the use of size limits assumes that fishing gear is well designed to mostly catch the intermediate sizes and/or that discarded spurdog survive. Small sharks in other fisheries can have higher survival rates than many finfish if they are returned to the water unharmed relatively quickly.

Incentives

Where EU recovery plans are introduced or where Commission or national emergency measures are adopted, compensation can be granted for one year, with the possibility of an extension for another year. Compensation can also be granted where EU legislation imposes technical restrictions on the use of certain gear or fishing methods. This measure offers significant opportunities to support the implementation of EU recovery plans, alongside other measures to pay for technical adjustments, capacity reductions, management planning, training, etc.

Monitoring, inspection and surveillance

Improved monitoring, inspection and control should accompany any recovery measures for those vessels affected by the management system. Underreporting and discarding are considered the factors most likely to undermine any recovery plan and therefore these two issues need to be addressed. Observers should be allocated to a number of vessels to collect data on other elements of the fishery including catch composition (target and non-target) and levels of discards.

Closed seasons

Improved monitoring of fisheries that catch spurdog may give managers the possibility to estimate the times or seasons when unacceptable levels of bycatch and discard occur. This could then be used to close a fishery if a given percentage of the catch contains undersized fish (‘real time closures’, i.e. local closures put in place rapidly in response to reports or catches of excessive amounts of juveniles). Real-time management and control requires real-time information, which the use of VMS and the implementation of observer programs can provide. Certain fisheries where bycatch is known to be high should implement such monitoring programs as part of a spurdog recovery plan.

Stock assessment and further research

The lack of research and monitoring activity targeted at elasmobranchs and the consequent lack of data on which to base assessments of threat, identify critical habitats and make recommendations for sustainable harvesting strategies currently makes it challenging to manage spurdog in Europe. The main indicator of stock abundance in existing stock assessments continues to be catch per unit effort (CPUE) data from logbooks, scientific surveys and catch returns (CPUE is a particularly inappropriate indicator of abundance for aggregating species like spurdog).

Development of assessments for spurdog is progressing and it is likely that this species will be able to be quantitatively assessed in the future. The use of a *Bayesian* surplus production model incorporating prior life-history information may be promising for this species. Considerable biological information is available for spurdog, although there is some uncertainty regarding age and growth studies, and up-to-date data regarding reproductive parameters are lacking. Information regarding the short-term movements and aggregation behaviour is also lacking. A better understanding of these biological issues is required to address some of the assumptions made in various assessment models. Other data are also required to improve future assessment models for spurdog and should include: age and growth, length-frequency for landed and discarded fish, quantities and survivorship of discarded fish and examination of tagging data sets.

Detailed data from the fishery and from research surveys are needed to understand the spatial pattern of the spurdog stock(s) in order to make the best use of control measures such as closed areas. Further, research on bycatch reduction devices is urgently needed in order to speed the development of better methods to avoid bycatch of this highly vulnerable species.

New research can be used to develop and adapt management and control measures over time. While precautionary measures are needed immediately because of the vulnerability of the spurdog stock, these measures can be adjusted in future as new information becomes available to minimize financial losses to the fishing industry while providing much better resource conservation.

Summary of Recovery Measures

The spurdog fishery is a good example of a resource where biological and fishery data are quite limited, but recovery is clearly needed. The compression of the size and age composition to smaller and younger fish, the inability of the fishery to attain the quota and the clear reduction in landings even though effort has increased are all evidence of a resource under severe stress from overfishing. In a similar vein, the needed recovery measures, even though the data are sparse, are also clear.

1) The overall exploitation of spurdog, including the directed fishery and associated fisheries that catch and discard or land this species, must be reduced by a large amount. The low productivity rate of this species means that it is even more important to restrict the fishery to very low exploitation rates to allow recovery of the resource.
2) Bycatch reduction is needed immediately. This should be accomplished through a combination of incentives for the use of gear which specifically reduces the bycatch of spurdog (i.e., bycatch reduction devices in the fisheries where bycatch currently occurs), and closed areas where spurdog are aggregated based on historical catches and surveys. Bycatch reduction is needed immediately. Overall monitoring of the catch of spurdog must be improved. As noted above, observer programs are necessary for estimating the discards, but landings must be more accurately assessed as well and these data must be available for assessment in a timely manner.
3) Research on the spatial and season pattern of spurdog abundance will enable the more effective use of closed areas and seasons to protect and help recover the resource. This research should be undertaken without delay. Closed areas and seasons should be implemented with the information currently available and then refined as the results of the research become available and on an ongoing basis.

For recovery to occur, clear action to reduce fishing mortality of spurdog is urgently needed. A precautionary recovery plan should be implemented immediately to begin the process using the measures described here.