Mixed Stock and Intercept Fisheries in Europe (Chris Maines)

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The concept of 'mixed stock' salmon fisheries should not be confused with the same term used in the context of marine fisheries. In the latter case, it refers to fisheries which target one species (e.g. herring or cod) but which also catch other species (e.g. mackerel or other white fish). Thus, the mixed stocks in these marine fisheries generally refer to 'mixed species'. In the case of mixed stock salmon fisheries, however, the term has been used in various ways to describe the exploitation of salmon originating from several different areas.

For salmon fisheries, there is no agreed definition of 'interceptory' or 'mixed stock fisheries' (MSFs), although the terms have been widely used, mainly to describe offshore fisheries in both distant and home waters. The term 'interceptory' has been most commonly used by those with management or ownership interests within individual rivers and has therefore been used to describe fisheries that intercept salmon on their return migration to their home river. However, given that a fish on its spawning migration is trying to return to a particular spawning area, the term could equally be applied to many of the fisheries, both rod and net, that operate within the river.

'Mixed stock salmon fisheries' have also been referred to for many years although there is no single clear definition. This has partly been because of the vague and variable use of the term 'stock', but also because the extent of mixing may vary both in terms of the total number of stocks exploited and the predominance of one (or more) stocks in the catch. Most fisheries, even within rivers, take salmon from more than one 'population', and many, even those operating in estuaries and the lower reaches of rivers, take salmon returning to more than one river. This is because fish migrating along a coastline towards their 'home' river often stray into foreign estuaries for variable periods. However, the degree of 'mixing' may be difficult to define since it may be measured in terms of the number of stocks exploited, the relative levels of exploitation on them or their relative contribution to catches.

When fisheries operate close to a river mouth, the local river stock will often predominate in the catch, because the fish may congregate outside the river mouth or in the estuary waiting for suitable conditions before moving upstream. Further from the river, and further offshore, there may be less predominance of single river stocks, and the degree of stock mixing generally increases. However, these general rules may be significantly affected by the relative size of the different river stocks in the area, their migration routes and the local topography.

It would be appropriate for the definition of MSFs to be related to the primary fishery management objectives determined by the North Atlantic Salmon Conservation Organization (NASCO). Thus, if the principal management objective is to maintain river stocks within precautionary limits, then MSFs might be considered to be 'those fisheries exploiting salmon from more than one river'. There are some dangers with this argument because the definition of the river stock as the primary management unit was itself predicated on the difficulties of managing at finer scales. However, such a definition on MSFs would clearly include nearly all fisheries operating in coastal and oceanic waters, but would also encompass many fisheries operating in estuaries and the lower reaches of rivers, since even when these take fish predominantly from a single river, they also frequently take occasional fish returning to neighboring systems. Determining the point at which such interceptions may be of concern will depend on various factors, including the relative size and status of the stocks, and the absolute and relative levels of exploitation on them.

Collecting such information for every estuary fishery, to decide whether it conforms to a predetermined definition of an MSF, would be difficult and costly. For current purposes, a more pragmatic approach is required and this could be based upon topography, and MSFs might be defined as any fisheries operating outside estuary limits. The majority of fisheries operating outside river estuaries are known to take salmon from more than one river stock, while within estuary limits, it is unusual (where data are available) for fisheries not to be taking predominantly fish from a single river. This conforms to the International Council for the Exploration of the Sea (ICES) advice which states that fisheries in estuaries and rivers are more likely to fulfil the requirement of targeting stocks that have been shown to be within precautionary limits.

In order to apply the definition consistently, a 'river' should be regarded as the whole water system discharging through a single estuary (including where two or more water courses discharging through this estuary have been given different river names). The precise geographical limits of any river estuary, and thus the fisheries that it encompasses, may sometimes be difficult to define, especially on a coastline with large inlets or fjords, as on the west coast of Scotland. Such limits will therefore need to be defined by the local jurisdiction. Similarly, there are likely to be borderline cases which require special attention. Thus there will certainly be some estuary fisheries which catch significant numbers of fish from neighboring rivers and some coastal fisheries which exploit predominantly a single stock. Specific management approaches may be required, or justified, by national or local managers in such cases.

For fisheries operating within a river system and its estuary, there is still a need to protect the diversity of the stock and its populations. In particular, the effect of fisheries on different sea age groups requires particular attention because they may be selectively affected by both natural and anthropogenic factors as a result, for example, of the different timing or routes of their migrations. Management authorities have the responsibility of ensuring that due protection is afforded to all populations within the river. In a small number of cases, fisheries within a single river may be managed by more than one authority or even jurisdiction. Where this is the case there is particular need for co-operation, and particular attention may need to be given to the assessment and regulation of fishing activities.

MSFs make salmon fishery management more complicated because it is difficult to identify or control how many fish are being taken from each river stock. The fishery may therefore need to be regulated without full knowledge of the status of all the stocks being exploited or the potential impact of the fishery upon them. Even where studies are undertaken to estimate these impacts, inter-annual variation in the size of stocks, their run-timing and other factors, such as weather conditions, may add significant uncertainty to the assessments.

MSFs frequently result in the harvesting of fish from stocks outside the sphere of authority of the management agency. Thus the fisheries can have adverse effects on stocks in another region or Member State and may conflict with management objectives being applied to those stocks (e.g. if one jurisdiction has closed all fisheries in order to meet conservation objectives).

Unless management measures in an MSF allow for a high probability of meeting conservation limits in smaller stock units (e.g. rivers), or at least the possibility of effective rebuilding of weaker stocks or populations, the fishery may have undesirable and irreversible impacts. The most obvious example is where at least one of the exploited river stocks is well below its conservation limit, and managers have determined that it should not be exploited at all. Assuming the MSF in question cannot avoid capturing these stocks, it would need to be closed if the management objective was to be realized.

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It is possible that where only a small number of stocks are known to be exploited by a fishery, for example within an isolated geographic area, it may be possible to manage the fishery on the basis of protecting the weakest stock(s), provided annual assessments are available on the size of the spawning stock relative to the conservation limit. Alternatively it may be possible to modify the fishery to operate outside the time of the main runs of the sensitive stocks. However, such exploitation will always present greater risks than when stocks are exploited separately because of uncertainties, or variability, in the proportion of the catch originating from the weak stock(s).

Further complications arise where large numbers of stocks are exploited by a fishery. Considering the current information on the status of most North Atlantic stocks, it is quite likely that one or more of the exploited river stocks will be below its conservation limit. Thus the continued operation of the MSF almost inevitably results in contravention of the management objective.

Even where all exploited stocks are meeting their conservation limits, as may occur if we return to conditions of higher marine survival of salmon stocks, MSFs introduce greater uncertainty into predicting the effects of management measures and pose a greater threat to small stocks or populations, especially if these are of low relative productivity and/or subject to high exploitation. As the number of stocks (or populations) increases, the number of fish that must be released from the fisheries in order to meet conservation limits must also increase. When the number of populations is too large, it may be impossible to ensure a high probability of the simultaneous achievement of spawner requirements in each individual unit.

Thus there is an inherent contradiction in the operation of MSFs and the conservation of all stocks that contribute to it. Ultimately, fisheries managers must decide between two options (Crozier et al, 2003):

- Mixed stock fisheries will be permitted but low productivity stocks will not receive the spawning escapement that would be optimal for their productivity levels (which would be contrary to NASCO objectives); or
- Spawning requirements of individual rivers must be respected at all costs and mixed stock fisheries should be eliminated.

These concerns have repeatedly been reflected in management advice, for example from ICES. Thus, for all fisheries in 2005, ICES (2005) considered that management should be based upon assessments of the status of individual stocks, and noted that fisheries on mixed stocks, either in coastal waters or on the high seas, pose particular difficulties for management, as they cannot target only those stocks that are within precautionary limits. ICES also noted that conservation would be best achieved if fisheries can be targeted at stocks that have been shown to be within precautionary limits, and fisheries in estuaries and rivers are more likely to fulfil this requirement.

MSFs present particular threats to stocks which are below conservation limit and some of the reasons for this are discussed above. Thus, while MSFs need to be evaluated on a case-by-case basis, there should be a general presumption against operating such fisheries unless they can be shown not to contravene basic conservation policies. Exceptions might be permitted it there is an essential socio-economic requirement that has been clearly identified, as long as no stocks exploited by the fishery are under threat of serious depletion.

Socio-economic arguments should be very carefully considered if conservation requirements are to be superseded and should be restricted, as far as possible, to situations where all stocks being exploited originate from within the same jurisdiction.

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It is possible that different jurisdictions will apply different socio-economic valuations to fisheries and this may complicate the task of managing fisheries that intercept fish from other jurisdictions.

There should therefore be a responsibility on the jurisdiction in which the MSF operates to establish that the fishery does not pose unacceptable threats to stocks in another jurisdiction or to take measures which can be shown to significantly reduce these threats where these are identified. This may require an agreed collaborative assessment or an independent assessment carried out by parties acceptable to both jurisdictions.

Where fisheries are operated, precautionary management calls for the 'appropriate placement of the burden of proof', and this requires a reversal of the approach that has hitherto been common practice. Managers have traditionally faced strong socioeconomic and political pressures to protect fishing interests, often leading them to seek clear evidence of a conservation need before they would introduce measures to protect stocks. The onus, based on the adoption of a precautionary approach, should now be placed on those wishing to maintain or develop a fishery, to demonstrate that the fishery will not have unacceptable effects. The precautionary approach also requires that decisions are not deferred simply on the basis of imperfect evidence.

MSFs for salmon are widely considered to be inappropriate because the lack of information on the stocks being exploited make the conservation and rational management of individual river stocks more difficult. If this is the case, it might in theory be possible to manage the MSF in conjunction with other single stock fisheries, if sufficient information was available on the stocks being exploited by the fishery. Options may exist, or be developed, to improve the information-base used to manage the fishery such that all stocks are identified and levels of exploitation are adjusted within precautionary limits. For example, tagging studies or Genetic Stock Identification (GSI) might be used to provide specific information on the composition of the catch in the fishery over space and time, and to assess the effects on individual river stocks.

Of course, the first prerequisite is that there should be zero or minimal exploitation of stocks that are failing to meet management objectives with respect to conservation limits. Assuming this is the case, the amount of information required could be balanced against the anticipated level of exploitation: thus one might require fairly precise information if the level of exploitation was between 10 and 20% but accept much less precise information if the exploitation was between 1 and 2%. A range of tagging techniques has been used in fishery management, and have been widely employed to provide information for salmon fishery management. Smolt tagging programs using coded wire microtags (CWTs) are extensively employed in the management of the Irish fisheries and have been used to provide baseline information for the management of UK fisheries which are intercepted in Irish fisheries. However, an obvious limitation of this approach is that reliable information is only obtained for stocks from which the tagged smolts originate. While the effects on some other stocks may be inferred or estimated, little information will be provided on possible interceptions of stocks from other areas. In addition, tagging studies, whether they be on emigrating smolts or returning adult fish, can be very expensive to run and may not therefore be a practical on-going management option when balanced against the value of the fisheries.

Even if it was possible to obtain information on the composition of the catches in a MSF, it may be difficult to reduce the risks of over-exploiting individual stocks without significantly reducing overall yields. The fishery would need to be managed on the basis of the weakest stock(s) being exploited in, for example, an average year.

Annual variation in the numbers of returning fish, their return times and migration routes of different stocks will also affect the certainty with which such approaches can be applied. Thus this approach is only likely to provide an acceptable management solution where the MSF exploits a very small number of river stocks, as may be the case for some fisheries operating within or very close to estuaries.

The number of stocks exploited in an MSF may be reduced, or the predominance of one stock in the catch may be increased, by limiting the areas where, or time when, the fishery may operate. For example, moving a drift-net fishery closer to the shore or a trap fishery closer to a river-mouth may have such an effect. However, such actions are unlikely to stop the fishery exploiting multiple river stocks, and their efficacy would need to be assessed on a case-by-case basis.

This approach was adopted in Ireland in 1997, when coastal net fisheries were restricted to operating within 6 miles of baselines rather than 12 miles. While this appears to have resulted in a reduction in the overall exploitation of UK stocks on average, the fisheries within each District still take fish from a large number of different rivers. Furthermore, the possibility of high interceptions in individual years or for specific UK, or Irish, stocks cannot be ruled out, and the measure are probably insufficient on its own to ensure an acceptable level of risk to these affected populations.

The fishing methods currently used in coastal waters, such as drift nets and fixed engines, could not generally be transferred into estuaries because of the nature of their operation. Even if it was possible they would almost certainly come into conflict with existing estuary and/or river fisheries. Thus, in many situations, this is likely to be only an interim measure or, at the least, would need to be monitored on a regular basis to ensure that exploitation of non-target stocks did not increase.

In some instances it may be possible to limit closures of the fishery to fixed periods, to allow stocks to rebuild to levels where some exploitation may be possible or to allow the collection of more detailed information on the patterns of exploitation by the fishery. This would involve obtaining a statutory closure, a commitment from fishermen not to fish or a specific buy-out for a set period . The disadvantage with this is that expected returns and rebuilding may not materialise and it will still require significant fisheries restrictions and close monitoring to ensure that all stock components being exploited are meeting conservation limits. The time scale for such a moratorium could also be excessively long as recent stock projection simulations (ICES 2005) suggest that a minimum time period of 7 years would be required to generate complete recruitment for one stock cohort, and depending on the productivity of the stocks and how far below the conservation limit they were to begin with, rebuilding periods of between 10 and 50 years (over 50 years in some instances) would be required. Thus, some stocks (e.g. river Tyne, England) have shown very significant improvements following measure to clean their estuaries, while others have shown little sign of improvement despite major restoration action (e.g. USA rivers). The time taken for stocks to recover will be dependent upon a range of other local factors and over the longer-term could be influenced by climate change.

In some instances a fixed-term moratorium on fishing for salmon may be feasible allowing stocks to rebuild to level where some exploitation may be possible. This would involve obtaining a commitment from fishermen not to fish, a specific buy-out for a set period (e.g. set-aside) or a mandatory closure. Where districts or rivers in a district are close to their conservation limit, full attainment or even exceeding conservation limits could occur within one season. However, several years may be required before this could be sustained from year to year. The subsequent reintroduction of the fishery would need to be based on the guiding principles outlined above, i.e. that fisheries should only take place in situations where there is a surplus of fish over the required spawner requirement in each stock and that the catch is regulated relative to this surplus. In most instances, the only fisheries that could be operated at acceptable

costs of monitoring and acceptable risks to all stocks are likely to be based on the exploitation of single stocks. Even in these circumstances there will still be a risk of under-escaping some component populations.

Where appropriate primary legislation is in place, the act of fishing for salmon in coastal waters or keeping any salmon caught in nets or traps fished for other species could be made illegal. Alternatively, individual fisheries could be targeted and closed by bylaw. In the absence of appropriate primary legislation, new statutes would be required. Depending upon the size of the fishery, immediate closure can have significant socio-economic implications within local areas.

In some jurisdictions, current legislation may only provide the regulatory authorities with powers to restrict fishing if there is a conservation or management requirement. Thus, measures to curb coastal fisheries may be subject to challenge if they were considered to be beyond the scope of the legislation or unreasonable. The closure of MSFs in line with general management principles may not be seen as falling within this area, and the imposition of management controls may lead to compensation claims. Ultimately, challenges might be taken to the Court, if plaintiffs considered that their Human Rights had been violated.

Where a decision is made to close an MSF, the impact on fishermen may be significantly reduced by phasing it over an extended period rather than instigating an immediate closure. This may be achieved by reducing the numbers of fishermen that may operate as existing participants retire. Such an approach may nevertheless have consequences for fishing communities because there is often an assumption that some children will follow their parent into the fishing industry. Phase-out procedures have been implemented in various mixed stock fisheries in England and Wales. In the North East coast drift net fishery, about 50% of the license holders retired from the fishery in the first 10 years of the phase-out.

However, this approach can also extend the closure over a very long period, possibly of at least 30-40 years if there are some young fishermen operating. It may therefore be desirable to use the phase-out simply as a means to provide due warning and opportunity for fishermen to diversify into other fisheries or find alternative employment. Thus the phase-out might be operated over a 5-10 years period, with a complete closure after this time. Alternatively there could be a progressive reduction in the number of licenses that may be issued. With the latter approach, a mechanism would be required to determine who would be required to leave the fishery first; such an approach is therefore likely to be quite divisive. Where phase-out arrangements are instigated in a large fishery they might also be adjusted to take account of regional differences in both biological (e.g. the status of stocks) and socio economic factors.