Data collection priorities for an emerging multi-species fishery

1.0 Introduction

A live-capture fishery for wrasse emerged in the D&S IFCA district in 2015 and is described in detail in Davies (2016). The fishery targets a range of wrasse species using relatively light-weight pots or traps set on or close to rocky reef habitats. Whilst the fishery has existed for several years in Scotland and Norway, and emerged in Cornwall in 2015, there is no information on the impact of these fisheries on stock abundance or dynamics, or on the indirect effects to rocky reefs. As a new fishery targeting species who spend their entire life-history in inshore waters and which occurs largely within Marine Protected Areas (MPAs), D&S IFCA has a duty to ensure the fishery is sustainable and does not negatively impact the features or site integrity of MPAs in the District. Very little data is available from existing wrasse fisheries on impacts of the fishery on stock abundance or reef ecology, but studies show local declines can occur (Davies 2016). Therefore D&S IFCA proposes new data collection is urgently required in the D&S IFCA district to inform fisheries management decisions.

2.0 Research priorities for an emerging fishery

Often the focus of sustainable fisheries management is the estimation of stock abundance and how this changes with varying levels of fishing pressure, with the ultimate goal of the delineation of a Maximum Sustainable Yield – a threshold at which the greatest quantity of fish can be taken from a fishery whilst maintaining some defined limit of stock abundance. However, being able to estimate MSY usually requires many years of detailed data to feed into stock assessments and the development of complex fisheries models.

In the absence of such data the most commonly used methods for quickly assessing stock abundance dynamics are: dedicated surveys, tagging and analysis of catch-per-effort distributions. Each of these has benefits and caveats, which are covered in great detail elsewhere (e.g. Hilborn and Walters 1992). They are discussed specifically in relation to the wrasse fishery in Sections 5.0 & 6.0.

However, the establishment of a catch data collection system is the top priority for a new fishery as most parameter estimation techniques for stock assessments require such data (Hilborn and Walters 1992). Such a system could include data collected from on-board observers, port landings or log books kept by the fishermen. The development of such a system for the wrasse fishery is described in Section 5.0.

In addition to collecting data on the direct effects of fishing effort on wrasse stocks, additional consideration must be given on the impacts of the wrasse fishery on overall ecology of the rocky reef systems of which they are part, and the potential interactions of the wrasse pots with the reef features. These are particularly relevant because the fishery occurs almost entirely within Marine Protected Areas (MPAs). Simply excluding the fishery from these areas is not desirable, as nearly all reef habitat is protected by some form of MPA in the District (and thus the fishery cannot simply move outside these areas).

3.0 Potential management mechanisms and data collection design

In contrast to much of the published work relating to fisheries management, Hilborn and Walters (1992) argue that the most important element of managing a new fishery is ensuring that an effective management mechanism is in place to manage the fishery when declines in some measure of abundance (such as Catch Per Unit Effort, CPUE) start to be detectable. This is because it is impossible to quantify the sustainable limit of a fishery until that limit has been exceeded. In the case of the emerging wrasse fishery, such a

management mechanism exists; the D&S IFCA Potting Permit Byelaw. The options for management within this byelaw also need to be considered in the design of any data collection, so that data can feed in to existing management mechanisms directly. Therefore, the primary options for management of this fishery include a limit on the number of pots allowed per vessel, the introduction of minimum landing sizes for wrasse and spatial and/ or temporal closures.

4.0 Fishery complexity and survey design

The ultimate goal of much of the data collection will be to elucidate a relationship between some measure of fishing pressure and stock abundance. Whilst this is never an easy task (see Hilborn and Walters 1992), a number of factors make the emerging fishery a particularly complex one, and these will need to be taken into account wherever possible in the design of data collection and the interpretation of analyses.

The first of these is the multi-species nature of the fishery. As described in Davies (2016) the fishery centres around five species of wrasse, all with different life-history traits such as habitat requirements, size at sexual maturity, spawning season and depth range. Because of this they are likely to respond differently to fishing pressure. Additionally, it is likely that complex ecological interactions exist between these species which may affect any straightforward relationship between fishing pressure and species abundance.

The reef association of wrasse may result in a complex relationship between fisher behaviour and stock dynamics which is likely to make the relationship between CPUE and stock abundance particularly hard to discern: CPUE may stay high as fishers move from reef to reef even if the overall population is reduced considerably (known as hyperstability). Or the opposite may occur – where an early reduction in CPUE occurs because of local depletions on individual reefs but stock abundance remains stable as other reefs remain unfished (known as hyperdepletion). Hyperdepletion is generally thought to be the more likely scenario for sedentary fish stocks (Hilborn and Walters 1992). However, the exact nature of the interaction will be dependent on both fisher behaviour and sink-source ecological dynamics of wrasse populations, how these relationships differ between reefs of different physical characteristics (depth, exposure, size, habitat complexity) and, if the fishery moves into new areas, between different habitats (e.g. reefs vs seagrass). These factors will need to be taken account of during the design and analysis of any data collection.

Finally, careful consideration must be given to the relationship between wrasse behaviour and catchability in order be able to make assumptions about stock abundance based on patterns of CPUE. In any survey where the central objective is to provide indices of relative abundance over space and time, it is imperative that the basic survey sampling device should be one that catches fish in proportion to their abundance in that area (Hilborn and Walters 1992). If the sampling device (in this case wrasse pots) saturate – i.e. do not catch fish in proportion to their abundance at a given site, then careful experiments must be undertaken to measure how quickly saturation occurs under different abundance scenarios. Due to the territorial nature of wrasse (Davies 2016) it is highly likely that traps may saturate – i.e. fish may be present but unlikely to enter the trap once the trap becomes ‘saturated’. This saturation may be size, sex and/or species dependent and must be considered.

5.0 D&S IFCA short-term research priorities for wrasse

As mentioned in Section 2.0 the most commonly used methodologies for quickly gaining information about stock abundance dynamics are dedicated surveys, tagging and CPUE distributions.

Dedicated surveys using either a survey vessel or chartered commercial vessel allow for controlled, detailed data collections which are spatially un-biased (i.e. removing the complicating factor that fishermen tend to target areas with the highest fish density, thus biasing any extrapolations to stock abundance from CPUE). However, these can be extremely costly and may require some knowledge of stock distribution or fisher behaviour before they can be effectively designed.

Based upon the considerations detailed above, the most important aspect of data collection in the short-term will be the establishment of a catch data collection system. Due to the likely complex spatial interactions between CPUE and stock abundance and the need to undertake detailed MPA assessments, D&S IFCA officers believe that the implementation of a fully documented fishery is necessary. This should include:

1. *Detailed log books*

   Log-book data must allow for CPUE spatial data to be accurately mapped and therefore as a minimum, should include the following:
   - Start and End latitude and longitude for every of strings of pots
   - Date and time for deployment and recovery of each string
   - Number of strings fished
   - Number of pots/traps per string
   - Species composition of catch (if possible)

2. *On-board observers*

   Observers will allow for verification of the log-book data and allow for the collection of additional data. The additional information will help to inform our knowledge of basic ecology and stock dynamics, and will help to inform decisions on minimum sizes and parameterize future models, if these routes are deemed practicable/necessary:
   - Catch composition - species
   - Catch composition – size distribution
   - Sexual maturity indices

3. *Pot-saturation field experiments*

   Pot saturation experiments will be required to investigate the sampling efficiency/ pot saturation issue defined in Section 3.0. This is likely to involve using GoPro cameras to look at behaviour of fish around and inside pots in a variety of abundance scenarios.

6.0 D&S IFCA long-term research priorities for wrasse

Further consideration of more detailed dedicated research surveys will be given, such as depletion experiments or standardised CPUE experiments in over-fished and un-fished areas to inform the relationship between CPUE and stock abundance. This type of survey work will require significantly more resource than either the log-book data or on-board observer data collection activities described above. Additionally, the design of such survey work will benefit from an initial understanding of fisher behaviour and catch trends.

Ideally, data collection would occur over the entire stock distribution, but as most of the target species have distributions which span from the Mediterranean to the west Baltic Sea, this obviously is not possible.

The use of traditional mark-recapture tags has limited use in stock abundance estimates unless at least 25% of the population are tagged (Hilborn and Walters 1992). However, other useful information may be gained which could help to inform management measures such as average home range size and source-sink dynamics between different reefs or areas. Whilst literature is available on home range size for at least some wrasse species, understanding local movement patterns will be crucial in determining the efficacy of any planned no-take zones for wrasse, if these are considered at a later time. Similarly detailed genetic work using high resolution genetic markers (such as microsatellites) would provide complementary information on the amount of genetic mixing, for example along a cline on the south and south west coasts of England. Additional (and for the genetics, substantial) funding would be required to undertake both these pieces of work.

If a more local stock is thought to exist, then locally targeted full stock assessments may be possible in the future, an approach being developed by North Eastern IFCA for both shellfish and finfish (J Wood pers.comms.).

7.0 Suggested approach

A fully documented fishery utilising compulsory, detailed log books should be implemented as soon as possible and complemented with additional on-board observer data collection. CPUE should be mapped spatially and considered carefully in conjunction with factors described above to understand whether any relationship with stock abundance can be elucidated. Additional survey work to look at the saturation point of the pots used is also required in the short term to inform this work.

Long term survey options should be considered, based upon findings from initial data collection efforts and the scale of the fishery as it develops. A partnership including other IFCAs, Cefas and universities may be required in the long term to assess direct and indirect impacts of the fishery.

Depending on the outcomes of the literature review of potential ecological impacts of removing wrasse from rocky reefs, and implications for site integrity of MPAs a precautionary limit on effort may be required.

Long-term priorities include exploring existing genetic research into wrasse and exploring partnership opportunities and external funding for local applications of this research. External funding could also be sought for a mark-recapture tagging study to look at the level of movement between reefs, in tandem with the genetic work.

8.0 References

Davies S. (2016) A review of wrasse ecology and fisheries interactions, D&S IFCA paper. September 2016.

Hilborn R. and Walters C.J. (1992) Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainty, Springer Science+Business Media, Dordrecht.