

CASE STUDIES IN MAXIMIZED RETENTION AND MONITORING FOR THE NEW ENGLAND HERRING FISHERY

M. Alan Lovewell¹

New England Fishery Management Council, Newburyport, Massachusetts, U.S.A.

Abstract

Maximized retention (MR) is a fisheries management policy that aims to minimize discards by encouraging or requiring that all or most fish caught are retained and brought to port. There are ethical, economic, and ecological reasons for adopting a maximized retention policy, as well as potential drawbacks in certain cases (e.g., when discarded fish would have survived and reproduced). However, in most cases, maximized retention may help provide the greatest net benefit in a fishery, and is therefore receiving increased interest across the globe. Enforcing maximized retention calls for effective catch monitoring, and monitoring limitations (resources, funding) can determine which policy options are feasible. This paper examines the various implications of maximized retention and catch monitoring, environmental and socioeconomic.

¹Acknowledgements: Lori Steele, New England Fishery Management Council, Newburyport Massachusetts, U.S.A., Jacob P. Kritzer, and Emilie Litsinger, Environmental Defense Fund, Boston, Massachusetts, U.S.A., Christopher Brown, Rhode Island Commercial Fishermen's Association, Point Judith, Rhode Island, U.S.A.

Executive Summary

This paper is divided into two main sections; the first section is an overview of catch monitoring and ways to achieve monitoring needs, this section will also discuss maximized retention (MR) policies and considerations to take when devising a MR program. The second section presents several case studies on various MR and catch monitoring programs, specifically addressing MR and catch monitoring management strategies and goals of the programs, and various costs associated with their development.

Norwegian Discard Ban

In 1987, Norway implemented a ban on discards for 19 species of pelagic and demersal fishes and invertebrates. Currently, the ban includes almost all potential bycatch species. Monitoring is based on a combination of at-sea surveillance by the Coast Guard, and dockside monitoring by the Directorate of Fisheries. Although this approach cannot detect all violations in the absence of observers on vessels, the Ministry adopted the ban as a matter of principle even in the face of incomplete effectiveness².

Scottish Discard Reduction Strategy

Norway has called for other European nations to take equally aggressive action in reducing or eliminating discards, and Scotland has arguably been the nation that done most to answer the call. Scottish fisheries policy calls for reduction and eventual elimination of discards. However, inability to effectively monitor a ban has resulted in this being a goal rather than a requirement to date. Instead, Scotland aims to achieve maximized retention through a combination of spatial and gear controls resulting in more selective fishing³.

Pacific Shoreside Whiting

Shoreside whiting, one component of the larger U.S. Pacific groundfish fishery, faces problems with salmon bycatch. Rather than requiring sorting and discarding of salmon at sea, Amendment

² Norway Ministry of Fisheries & Coastal Affairs. 2009. Norwegian fisheries management, our approach on discard of fish. Fact sheet available at

http://www.regjeringen.no/upload/FKD/Brosjyrer%20og%20veiledninger/fact_sheet_discard.pdf

³ Government of Scotland. 2009. Sustainable Scottish fisheries and MSC certification. Policy paper available at <http://www.scotland.gov.uk/Publications/2009/05/13115802/2>

10 to the Groundfish FMP calls for maximized retention to account for salmon bycatch mortality in port⁴. Although the Pacific Council is already considering Amendment 22 to the FMP, Amendment 10 has been implemented, but NMFS has yet to make a Final Rule. However, adoption of an ITQ system for the whole of the fishery through Amendment 20 might provide the needed incentives and pressure to overcome this hurdle.

British Columbia Groundfish

The British Columbia groundfish fishery operates under a catch share system, specifically allocation of tradable individual vessel quotas. Full or maximized retention is not required. However, 100% monitoring by either at-sea observers or video systems, depending on gear, allows full accounting of catch, and deduction of discards from quotas using assumed discard mortality rates. This incentive-based approach has resulted in a significant decrease in discards⁵.

Area A Crab Fishery

The Area A crab fishery is an example of a well designed and effective monitoring program brought about by the collaboration of Industry and Government. Utilizing the Archipelago monitoring system, the fishery has been able to ensure compliance and a level playing field amongst a fishery that during the 1990's experienced substantial losses due to illegal fishing practices.

⁴ National Marine Fisheries Service. 2007. A maximized retention and monitoring program for the Pacific whiting shoreside fishery. Draft environmental assessment.

⁵ Branch, T.A., K. Rutherford and R. Hilborn. Replacing trip limits with individual transferable quotas: implications for discarding. *Marine Policy* 30: 281-292.

TABLE OF CONTENTS

| | |
|---|----|
| 1.0 INTRODUCTION | 6 |
| 1.1 Implications | 6 |
| 1.2 Results | 7 |
| 2.0 DISCARDING | 7 |
| 3.0 CATCH MONITORING | 9 |
| 3.1 At Sea Observers | 9 |
| 3.2 Dockside Observers | 9 |
| 3.3 Electronic Monitoring | 9 |
| 3.3.1 Archipelago | 10 |
| 3.3.1.1 Rental and Purchasing fees | 10 |
| 3.3.1.2 Installation and Analysis fees | 11 |
| 3.3.2 Electric Edge Systems Group Inc. | 11 |
| 3.3.2.1 Vessel Trip Tracking | 11 |
| 3.3.2.2 Accessibility | 12 |
| 3.3.3 S-VDR (Simplified Voyage Data Recorder) | 12 |
| 3.3.3.1 Utility | 13 |
| 3.3.3.2 Cost | 13 |
| 4.0 MAXIMIZED RETENTION AND FULL RETENTION | 14 |
| 4.0.1 Full Retention | 14 |
| 4.0.2 Maximized Retention | 15 |
| 4.1 Economic and Social Impacts | 15 |
| 4.1.1 Financial and Revenue Shifts | 15 |
| 4.1.2 Data Accuracy..... | 16 |
| 4.1.3 Vessel Safety | 16 |
| 4.2 Environmental Impacts | 17 |
| 4.2.1 Monitoring and Sampling | 17 |
| 4.2.2 Changes in Fishing Practices | 18 |
| 4.2.3 Innovations | 18 |
| 5.0 CASE STUDIES | 20 |
| 5.1 NORWAY | 20 |
| 5.1.1 Policy Impetus | 21 |
| 5.1.2 Vessels and Gears | 21 |
| 5.1.3 Market | 21 |
| 5.1.4 Maximized Retention | 21 |
| 5.1.5 Slippage..... | 23 |
| 5.1.6 Management | 23 |
| 5.1.7 Management Objectives | 24 |
| 5.1.8 Shared Stock | 25 |
| 5.1.9 Enforcement and Control | 25 |

| | |
|---|-----------|
| 5.2 SCOTLAND | 27 |
| 5.2.1 Monitoring & Compliance | 28 |
| 5.2.2 Slippage | 28 |
| 5.2.3 Landings | 29 |
| 5.2.4 Maximized Retention and Discarding | 29 |
| 5.3 UNITED STATES | 31 |
| 5.3.1 Policy Impetus | 32 |
| 5.3.2 Management | 32 |
| 5.3.3 Policy Development | 33 |
| 5.3.3.1 Full/Maximized Retention | 34 |
| 5.3.3.2 Monitoring | 34 |
| 5.3.3.3 EMS | 35 |
| 5.3.3.4 Overages | 35 |
| 5.3.3.5 Recordkeeping and Reporting | 35 |
| 5.3.6 Bycatch | 36 |
| 5.3.7 Costs | 36 |
| 5.3.4 Alternatives | 37 |
| 5.3.5 Catch Monitoring | 40 |
| 5.3.6 Bycatch | 41 |
| 5.3.7 Costs | 42 |
| 5.4 BRITISH COLUMBIA | 43 |
| 5.4.1 Policy Impetus | 43 |
| 5.4.2 Full Accounting | 44 |
| 5.4.3 Monitoring and Compliance | 44 |
| 5.4.4 Management | 44 |
| 5.4.5 Costs | 45 |
| 5.4.5.1 Dockside Monitoring Program Costs | 45 |
| 5.4.5.2 At-Sea Observers | 45 |
| 5.4.5.3 Electronic Monitoring | 45 |
| 5.4.5.4 Installation and Analysis fees | 45 |
| 5.5 BRITISH COLUMBIA | 47 |
| 5.5.1 Policy Impetus | 47 |
| 5.5.2 Electronic Monitoring | 48 |
| 5.5.3 Cost | 48 |
| 5.5.4 Enforcement | 49 |
| 6.0 CONCLUSION | 49 |
| Appendix I | 51 |
| Appendix II | 51 |
| References | 55 |

1.0 INTRODUCTION

The New England herring fishery has recently come under pressure by many organizations due to the lack of data gathered about the rate of discarding, slippage and bycatch rates. One of the catalysts for this scrutiny has come from the declining river herring stocks along the eastern seaboard, and the communities and resources that depend on its abundance. There is also concern that there are significant numbers of haddock bycatch, specifically in groundfish closed areas. It has been reported that midwater nets are capable of passing very low in the water column, operating just above the bottom, having considerable interaction with juvenile and adult haddock, potentially disrupting these important spawning grounds. For the purpose of clearing the pressure on the industry, increasing scientific accuracy, and environmental resource efficiency gains we need to look at improving catch monitoring and look at maximized retention feasibility to develop solutions to any bycatch problems that are identified. The significance of bycatch is described in a study done by the FAO: “The 1994 figures showed an estimate of global discards in marine fisheries indicating that 27 million tonnes, or approximately 27 percent of the global catch, were discarded annually. The initial estimate was a major achievement, providing the order of magnitude for the estimate of global discards and illustrating the difficulty in estimating global discards, as indicated by the wide range of the estimate (17.9-39.5 million tonnes)⁶.”

1.1 Implications

The implications of discarding affect all aspects of the global fishing community. It represents an efficiency loss in our extraction of natural resources, and environmental impact caused by removing more from the ecosystem than is necessary for our harvest, and finally it represents a economic loss for industry and governments that manage and profit from the oceans bounty. And ultimately, it reminds us that fishing practices, management, and economic strategy can potentially be improved to address this problem. The challenge for fishery managers and industry

⁶ Alverson, Dayton L., Freeberg, Mark H., Murawski, Steven A., Pope, J.G. A global assessment of fisheries bycatch and discards. Food and Agricultural Organization (FAO). 1994.

is to finding where those efficiency gains and improvements can be made, cost effectively and with the most benefit.

1.2 Results

Wasteful discards are a problem in many fisheries worldwide. Sometimes, discarding is a decision by the fisherman. But often discarding is forced upon the fisherman by regulations that limit catch of a given species by trip, by day, or by season. A shift from such input-based controls to output-based management, especially limited access privilege programs (LAPPs) or catch shares can eliminate the need and incentives for this waste. A shift to output-based management systems opens the door to the possibility of using maximized retention as a policy in many fisheries, at least of primary target species and perhaps of bycatch species as well. This is a policy that has been recommended by several agencies and organizations, and even implemented in a handful of fisheries across the globe. There are many reasons to move toward full retention, including ethical considerations, fishing efficiency and cost-effectiveness, but there are potentially costs, shifts in fishing practice, environmental impacts, and economic repercussions that should be taken into consideration that could have significant consequences as to whether or not MR is implemented and if it will be successful.

2.0 DISCARDING

Both catch monitoring and maximized retention are management tools designed for getting a better understanding of what is caught and not brought to port. This is beneficial for all aspects of the fishery; industry, environmentalists, scientists, and managers. The most accurate readily available information for the improved understanding of the fishery is in the nets of the fishing vessels. There is a lot of difficulty associated with knowing what is contained in the net because after the catch is pumped into the holds, there may be residual fish that either doesn't pass through the pump or the volume of the fish in the net is not sufficient for effective pumping. Furthermore not everything that is pumped on deck is kept – haddock, codfish, and dogfish are all example of fish that may pass through the pump, but may be thrown overboard. And in some rare cases, not everything that is pumped into the holds is brought to shore; there are examples of tanks being emptied back into the ocean for the purpose of high grading, or removing damaged

or spoiled fish. The uncertainty of not knowing what is in the net is also compounded by the fact that not all vessels have observers on board to record the catch composition, so what is brought to shore is not representative of what is caught. These discards represent a level of scientific and management uncertainty that could be improved to create a better understanding of the health of our ecosystems and in calculating more accurate annual catch limits (ACLs) with minimized uncertainty reductions.

Amongst all fisheries, there are various forms of discarding, but they can all be categorized into three main forms. The first form of discarding occurs when the catch is brought on board and targeted fish is kept and non-targeted fish are thrown over the side. A second form of discarding occurs while the net is in the water, the some or all the contents of a set is discarded. This is known as "slippage." Finally, there is discarding that occurs when fish escape the net, which occurs at all times during a tow, but most frequently if the vessel loses speed while the net is being retrieved.

The reasons for discarding include, but aren't limited to:

- Fish of the wrong size
- Fish of the wrong species
- Fish are damaged or spoiled
- High grading
- Lack of space on board or in the hold
- Species quota reached
- Year class variation
- Season
- Gear failure
- Safety

The above-mentioned reasons for discarding can be brought about by economic, legislative, and routine fishing practice.

3.0 CATCH MONITORING

Catch monitoring is achieved at-sea and dockside, by government or third-party observers or electronically with cameras and various sensors that monitor vessel activity. Catch monitoring is used to ensure compliance with regulations, as well as provide important data on catch composition.

3.1 At Sea Observers

Observers provide potentially the most accurate and reliable form of monitoring coverage, allowing for species identification and temporal specific data. The cost of such comprehensive coverage can be high, and safety as well as space aboard the vessel can be of significant concern. Regardless, many fisheries choose to provide this kind of monitoring because it accomplishes many objectives with one service and cost. Likewise, these programs are not necessarily port-specific; typically, the only limitations are that observers must be able to be dispatched in a timely and reliable manner to boarding and landing locations.

3.2 Dockside Observers

Dockside observer coverage is typically used to facilitate real-time landing composition assessments that includes number of species, size, and weight, gender, etc. The data is used to compare vessel catch logs, to ensure accurate self-reporting. Dockside monitoring benefits include less hazardous conditions for conducting assessments, as well as less time restrictions for sampling landings. Depending on the fishery, a potential limitation is the site-specific nature of the system, which may reduce the number of ports vessels can offload.

3.3 Electronic Monitoring

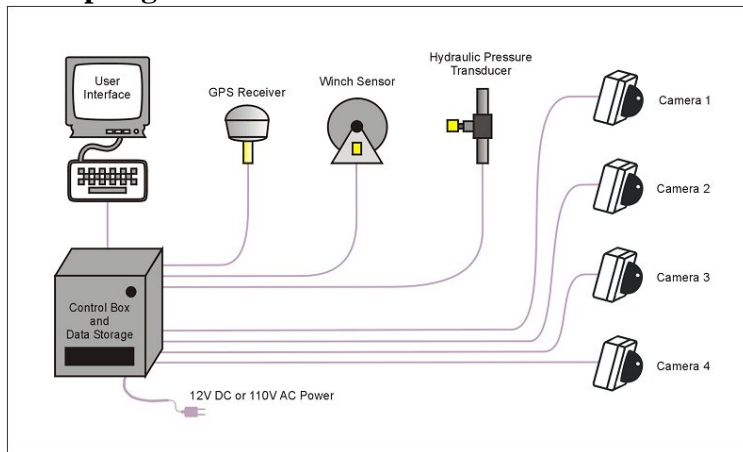
Electronic monitoring is, in general, the more cost-effective form of monitoring, providing a more enforcement-based system rather than science or data-based. Regardless, many fisheries use electronic monitoring because it has been able to provide higher levels of coverage. Issues associated with electronic monitoring include: who owns the data once its collected, who has

access and for what purpose, how to handle the large volumes of data, archiving restrictions, and finally, compatibility across various monitoring systems and data series.

3.3.1 Archipelago

Below is a description of the most widely used third-party monitoring system, provided by Archipelago Marine Research Limited. The costs associated with this system are based on the Canadian Pacific Groundfish Fishery.

Archipelago



3.3.1.1 Rental and Purchasing fees

- \$55/day rental for entire custom design weather and tamper-proof system – includes keyboard, monitor, CPU, 2 cameras, hydraulic pressure transducer, winch sensor, and GPS receiver
- \$45/day rental for keyboard and CPU if vessel owner has purchased the peripherals (cameras, sensors, monitor - cost of \$2000)
- \$8950 to purchase entire system

Along with these various options for rental, there is also a rent to purchase plan where 95% of rental fee is applied against purchase price.

3.3.1.2 Installation and Analysis fees

- \$36/hr servicing fee for installation, removal and repairs (average installation is 2-3 hours, average removal is 1 hour)
- \$36/hr for analysis of logbook, imagery, and sensor data (analysis time ranges from 2 – 8 hours depending on trip length, # of sets and measurements, species diversity, and quality of data)

3.3.2 Electric Edge Systems Group Inc.

The Fishery Operation System (FOS) is an integrated fisheries management database designed by Electric Edge Systems Group. FOS stores, organizes and reports on all data relating to hails, offloads, and logbooks to a central database that is accessible to the government and third party contractors like Archipelago. The database is able to track commercial activities across multiple fisheries, and is capable of merging the quota and catch data to calculate the remaining quota for each license, which took considerable amounts of time when it was done manually.

3.3.2.1 Vessel Trip Tracking

When a vessel first “hails out,” usually via VHF radio, the vessel provides departure date, time, license, skipper, anticipated catch offload location. At the end of the trip the vessel “hails in” to inform FOS that they are concluding their trip.

Between hailing in and hailing out, an electronic or written log is kept which includes the details of each fishing “set,” the number of fish caught, the species composition, and the number of species retained or discarded, this data is either recorded by the skipper or an observer. At the conclusion of its trip, the vessel will offload and a dockside monitor will document and record the offload of catch.

With the vessel log and the dockside monitors log, FOS consolidates the information via a “Quota Catch Merge” process. The merge process takes all the information and sorts and resolves potential discretion between the vessel log and the offload log; fishing information that is missing in the offload log is then supplemented by the vessel log. Catch that is used for bait, or

food for the crew that doesn't show up in the dockside log but is recorded by the vessel log is applied to the quota. Another point of discretion that FOS can resolve is with species identification. Species that are hard to differentiate from each other like shorttraker rockfish, and roughey rockfish are considered partner species. If one is misidentified at sea, and is properly identified at shore, then FOS looks to see if any of the other species was accounted for and then resolves any discretion between the species and their accounting by assuming a species was misidentified and then applying that misidentified partner species into its appropriate quota location.

3.3.2.2 Accessibility

FOS is available to third party contractors via Internet. This allows contractors to maintain their in-house systems, and ensures that both systems and all the data is up to date. This is all achieved with a variety of web platforms that provide synchronization of the data between systems.

3.3.3 S-VDR (Simplified Voyage Data Recorder)



There are various examples of S-VDR systems that were designed for the shipping industry as systems to record maritime vessel incidences. Northrop Grumman's marine division, Sperry Marine, manufactures a vessel data recorder intended for compliance with the International Electrotechnical Commission (IEC) and the International Maritime Organization (IMO) guidelines: MSC.163 (78), IEC 61996 and IEC 60945, which requires all vessels over 2000 tons to be equipped with S-VDR. The requirement includes the ability for a ship to record its position,

date, time, speed, radar, VHF and bridge audio, and heading for 12 hours of continuous back logged data. The data is stored in a data capsule that is pressure and fire resistant similar to a black box on an aircraft. Auxiliary data storage is possible with the use of a thumb drive or networked hard drive for increased storage capacity. The use of this technology has primarily been for the shipping industry and up until this point has not been utilized on any fishing vessels.

Device components include a bridge alarm unit which acts as the user interface, the data capsule responsible for safely storing the data, a data acquisition unit that consolidates all the information for various forms of input up to 8 serial inputs, radar video card capable of recording 2 radar or cameras, with upgrade potential for up to 2 more additional units, and finally 4 microphone feeds and 1 VHF feed. The data is not encrypted and is accessible to the captain or inspectors at any time.

3.3.3.1 Utility

S-VDR can accomplish a variety of recordings, some of which may be valuable for the fishing industry. The data acquisition unit can record: audio from the VHF and bridge, GPS (date &time, latitude &longitude) Speed, heading, and main radar. The unit is also capable of recording depth beneath the keel, alarms, rudder order and response, engine order and response, hull opening status, watertight and fire doors, wind speed &direction, and hull stress monitor. The radar capture component of the devise can be arranged to capture images at 5 to 15 second intervals, with the capacity to input up to 4 cameras. There is no video capacity for this specific set-up, so the most likely utility of this image capture feature is for enforcement purposes.

3.3.3.2 Cost

The expense of this system can be broken down into two components, equipment and installation. As of March 2009, the basic equipment cost is \$17,500 which includes a data capsule, data acquisition unit bridge alarm, and two microphones for bridge and deck use. This does not include the peripheral equipment such as cameras, hydraulic sensors, winch sensors etc. Installation costs vary but typically are about \$100 per hour.

4.0 MAXIMIZED RETENTION AND FULL RETENTION

Also known as a discard ban, maximized or full retention as a policy tool serves two main purposes. First, it provides an incentive for the industry to be more selective in their fishing techniques, encouraging gear that minimizes bycatch and increases the relative volume of targeted catch. The other purpose it serves is to decrease the uncertainty of fishing mortality. As an industry tool, maximized retention has been used to allow vessels to retain and refrigerate all catch to minimize spoilage that occurs while sorting at sea, and also reduce the time vessels are at sea sorting and discarding.

Although mortality rates have gone up historically in maximized retention fisheries because catch survival rate is reduced to zero, the requirement to keep all catch allows the fishery managers and scientists to know actual fishing mortality and leaves little if any speculation for discard survival rate. Juvenile mortality may also increase initially, but it is possible for fishing practices to shift so that the fleet is collaboratively avoiding the catch of juveniles and bycatch. Fishing mortality that may still need to be accounted for include: gear interaction mortality and escaped catch mortality.

Based on the same concept, maximized retention and full retention are different and are not interchangeable, although often used interchangeably, but the flexibility, data, mortality rates, economic consequences, regulation, are all potentially unique and would have a variety of consequences depending on the regulatory structure of the two policies. If full retention marks one end of a continuum of fishing mortality, while unrestricted discarding marks the other end, then the middle of the stratification is various degrees of maximized retention.

4.0.1 Full Retention

Full retention technically means that all species – mammal, fauna, bird or fish – must be kept regardless of size, age, breeding state, sex, color, condition, etc. This is a non-discriminatory fishery where if you catch it, you keep it. This approach is being recommend to the European

Commission for the Common Fisheries Policy for ultimate accountability⁷. Full retention has been recommended to account for all that is caught in the net especially when little is understood about the gears impact on the ecosystem. Technically there is little, if any flexibility on what is retained or discarded.

4.0.2 Maximized Retention (MR)

Maximized retention, on the other hand, allows for flexibility within the management system and provides for the customization of a fishery based on the current management needs and objectives. Of course there is no blueprint plan for a maximized retention system, and therefore it encompasses a range of options for retainment. Most full retention systems are actually maximized retention programs that may have higher than normal requirements for retention. Regardless of the system, there are economic, social and environmental consequences associated with these types of systems.

4.1 Economic and Social Impacts

Under a maximized retention policy, the variety of market prices of all fish species at any given time limits the vessels ability to maximize its hold space to more profitable fish. In certain fisheries, the intermingling of species in a hold may damage other more marketable and desirable species. The utilization of one over another is very fishery-specific and species-specific. As a result, the fishery is incentivized to minimize the interaction of target species and bycatch in the hold. For example, the Pacific whiting fleets, discussed later in this paper, immediately refrigerate their catch because of the delicate nature and perishability of their catch. This minimizes damage by sheer volume of the catch and by interaction with potentially damaging species. Maximized retention may be utilized to increase profitability of catch as well as reduce time on the water (time sorting fish at sea.)

⁷ Discard Ban and the reform of the Common Fisheries Policy. Oceana. April, 2009.

4.1.1 Financial and Revenue Shifts

Fisheries such as various multispecies groundfish fisheries may take substantial financial losses based on their inability to discard unwanted fish, and occupying limited space to less valuable fish or unmarketable fish. Under a maximized retention program, there are currently very few technologies or options that can increase selectivity outside of discarding. The variables they have to control the selectability are; where and when they choose to fish, the depth of fishing effort, mesh size and various gear arrangements. Technologies are being developed to increase selectability of gear, such as excluder devices, upside down nets, etc.

Other various economic impacts include revenue distribution, assuming all gear types are allowed in all areas. In fisheries with multiple gear types, the gear type that is "cleaner" will be naturally more profitable as long as the production cost remains low. As the externality of bycatch is internalized by the industry, the methods of fishing that have lower bycatch rates will have less operational costs, subsequently the fishermen with the optimal gear type will benefit and those with the less optimal gear type making less revenue will be forced to either stop fishing or change gear types, as a result there could be a shift in the labor force as fleet composition changes.

4.1.2 Data Accuracy

Another important economic impact to consider is the likely increase in data accuracy as a result of monitoring that would reduce management uncertainty. By reducing management uncertainty, there could consequently be less reductions from the overall catch limit. This could benefit the industry by allocating more accurate quotas with smaller buffers. Selling bycatch and distributing the profits amongst the industry or government could provide further benefits.

4.1.3 Vessel Safety

Vessel safety is always a concern, and should take precedence over every other aspect of the policy. Video monitoring and observer coverage can provide evidence and documentation of exemplary conditions in which maximized retention compromises the safety of the vessel and/or its crew. To prevent abuse of a safety exception policy, clear parameters for discarding, preferred

methods, and special reporting procedures may need to be required. Advice from legal counsel may be necessary to find out what kind of binding documentation maybe necessary for legal substantiation. Along with clear, legally significant parameters, strict enforcement of the policy and severe penalties for non-compliance should be in place to ensure safety while discouraging abuse of the system.

4.2 Environmental Impacts

The importance of protecting endangered and overfished species increases due to potential increases in mortality rates brought about by discarding bans. Juvenile and spawning individuals mortality rates will likely increase due to the legal responsibility to retain them. A study conducted by the Institute of Marine Research, Norway; Fisheries Research Services, and the Scotland and Danish Institute for Fisheries Research, funded by the EU Commission called Project SURVIVAL looked at the survivability of various gadoid (cod, haddock, saithe, whiting) species after escaping the codend, either through and excluder or through the mesh. What they found was that the mortality of juveniles that escape the codend is much higher than those of more mature fish, most likely due to the injuries and stress associated with the capture itself.⁸ They also found that fish that escaped at the surface, juvenile or adult and amongst all gadoid species, had a very high mortality rate most likely due to hyperbaric injuries and suffocation at the surface.

4.2.1 Monitoring and Sampling

Potential benefits that have been realized by fleets managed with maximized retention are improvements in monitoring and sampling. When coupled with comprehensive portside monitoring, this program may allow for 100% of the catch to be documented more carefully and at lower cost. In addition to basic species composition and catch volume data, detailed biological data such as size, age, sex and genetic characteristics can be collected with greater precision, less error, and in greater quantity as observers are freed from the time constraints and distractions of

⁸ Soldal, Breen. "Survival" Surviving the trawl. 2003. www.profetpolicy.info/files/SURVIVAL.pdf. Date Retrieved July 24, 2009

collecting this data at sea. Also, safety risks faced by observers and obstacles that observers present to the crew are potentially alleviated when more data are collected onshore.

Of course, a shift toward maximized retention and greater portside monitoring also presents challenges and limitations. A degree of spatial and temporal resolution in the data can be lost, with the amount depending upon the fishing patterns of the fleet or vessel. There is also a need to ensure that all fish caught are in fact brought to shore. These issues can be addressed through electronic tools such as VMS, cameras and hydraulic monitors that provide coarse records of fishing activity and catch to be characterized in greater detail onshore. Ultimately, there will always be a need for at-sea observers to calibrate and ground-truth the data, but a shift toward maximized retention fishing and comprehensive portside monitoring can provide numerous environmental, scientific, financial and management benefits, that result in more accurate accounting.

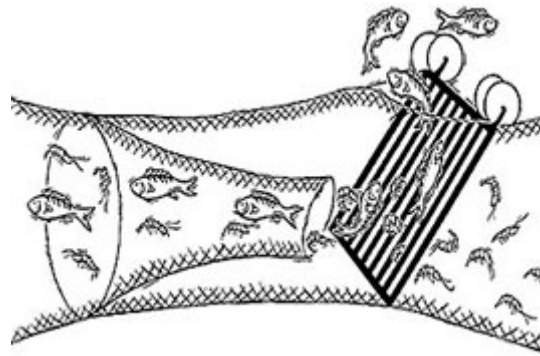
4.2.2 Changes in Fishing Practices

Another important result may be changes in fishing patterns; fishermen may now have stronger economic incentive to fish in areas with smaller proportions of bycatch. Areas that were once popular due to the volume of catch, are now less valuable than those areas that have higher concentrations of their targeted species. This can have positive and negative consequences, improving the selectivity of the fishery, but potentially creating fishing "hotspots", or areas where fishing effort gets consolidated and potentially over-exploited.

Maximized retention may cause a shift in gear preferences to increase selectability. As one method of fishing becomes less cost effective, the fleet will respond by fishing using another method that may increase percentage of targeted catch. It should be noted that increased selectability does not necessarily equate to a more environmentally responsible fishery, because a more selective gear may do more habitat damage or may increase the mortality of other species.

4.2.3 Innovations

Gear innovation is also a potential response to maximized retention. As space on the vessels becomes more valuable, and the bycatch becomes an avoidable expense, the fishermen and industry may react by implementing the use and development of gear modifications. In the example of the Norwegian herring fishery, the industry responded to the maximized retention requirements by incorporating the Nordmøre grid/grate. Originally designed for the trawl shrimp fishery to minimize bycatch of turtles and groundfish, the Norwegians appropriated it to minimize the bycatch of haddock and saithe. A study by Michael Davis addresses gear interaction mortality in a paper titled *Key principles for understanding fish bycatch discard mortality* which analyzes various physical and environmental factors that effect bycatch mortality.



5.0 CASE STUDIES

5.1 NORWAY

Target Species: *Clupea Harengus*

Management Area: 2.2 Million Square Kilometers

Stocks: Buchan, Banks, Downs

Value of Herring Fishery: \$312 Million

Management: Structural Quota System (SQS)

Certification: Marine Stewardship Council (MSC)

Product Utilization: Human Consumption

Date Achieved Maximized Retention: 1988

Innovation: Nordmøre Grid/Grate

The Norwegian North Sea herring fishery prosecutes two major spawning groups of herring; the spring spawning group and the autumn spawning group, the latter population being the more important and dominant catches for the fishery. Of these groups there are 3 major stocks, the Buchan or Scottish group, the Banks or central North Sea group, and the Downs group. These stocks are known to mix and therefore are caught in conjunction with each other. Proper management of the fishery is critical for maintaining the health of each stock component.

Tools such as the Nordmøre Grid and the triple ban fish finder have all increased the accuracy of the Norwegian fleet, increasing efficiency and selectivity.

5.1.1 Policy Impetus

Since 1988, Norway has implemented a ban on discarding fish at sea. This ban now applies to over 19 species of fish and shellfish; the goal of this measure was to increase the amount of information on total catches, as opposed to landings. Maximized retention is mostly supported by the fishing industry because it maximizes their fishing effort.

5.1.2 Vessels and Gears

The predominant vessel types that compose the Norwegian herring fishery are Purse seines and Pelagic Trawls (Midwater trawls). In 2007, the fleet composition was 100 purse seine vessels, 27 pelagic trawls (30 – 68 meters length) and 84 coastal purse seines. The volumes of catch associated with these vessels were; 86% from purse seiners, 7% from pelagic trawlers and 7% from coastal purse seiners.

5.1.3 Market

The North Sea Herring Fishery utilizes its catch for predominantly fishmeal and oil. Most fish are ground or frozen and several fillet at sea. The total for at sea processing for 2008 was 568 tonnes. The value of the 2002 total catch of herring was \$312 million. In 2006, the estimated value of herring total catch was \$106 million.

5.1.4 Maximized Retention

The discarding of any part of their catch of non-target species, bycatch, has been banned and all vessels are required to retain the following species alive, dying or dead, the requirement has been extended to include many more species but was fundamentally based on 17 preliminary species: Cod, Haddock, Saithe, Redfish, Mackerel, Norwegian spring spawning herring, Trondheimsford herring, North Sea herring, Greater argentine, Capelin, Greenland Halibut, Whiting, Blue Whiting, Angler (Monkfish), Shrimps, Snow Crabs, and Halibut.

The majority of bycatch from the Norwegian North Sea herring fishery is mackerel, and horse mackerel, with limited saithe, and blue whiting. All catch is landed and counted toward the species quotas they hold. If they do not hold quota or have surpassed their quotas for that

species, the proceeds of their sale is pooled and distributed by the sales organization (Norges Sildesalgslag) to the industry. The subsequent funds are used for monitoring, control purposes and marketing support for small coastal fleets.⁹

In 2005, the herring fishery pelagic trawls implemented the use of the Nordmøre grid/grate to sort out bycatch of cod and saithe. This reduced the levels of bycatch that the fishermen were legally responsible to keep, which in turn increased the efficiency of the fleet. One important factor that was taken into account with this measure was the survival rate of the bycatch that passes through the Nordmøre Grid. A study conducted by the Institute of Marine Research funded by the EU Commission found that mortality among younger fish was much higher than older fish due to the energy expended in trying to escape. The study also concluded that the survival rate for cod, whiting, and saithe was relatively high at 99%. For haddock the results were substantially lower and with more variability. The end result of this study was then used to reduce uncertainty in the stock assessments, which improved the accuracy of quota allocations and conservation efforts. To the benefit of the industry, "Trials conducted in the early 1990's demonstrated that the use of fish grids improved compliance with catch composition regulations sufficiently for the authorities to allow fishers access to closed areas."¹⁰

The success of the Nordmøre grid/grate in the Norwegian fishery has been widely regarded by many as the result of a policy that shifted from a minimum landing size (MLS) restriction type management strategy to a minimum catching size policy.¹¹ That said, it should still be recognized that minimum catching size-based policy is still one step away from fishing mortality, and that catch still does not reflect total mortality, it is just one step closer to obtaining that long-term goal.

⁹ G Pilling, J Nichols, A H Hoel, A Hough, S Davies. Norwegian North Sea and Skagerrak Herring Fisheries. Moody Marine Limited. 2008.

¹⁰ Isaksen, B., Valdemarsen, J.W., Larsen, R.B. & Karlsen, L. 1992. Reduction of fish bycatch in shrimp trawl using a rigid separator grid in the aft belly. *Fish. Res.*, 13: 335 - 352.

¹¹ Grahm, et al. Fishing Practice, gear design, and the ecosystem approach-three case studies demonstrating the effect of management strategy on gear selectivity and discards. July 30, 2006.

5.1.5 Slippage

There are no regulations that address net slippage, but it is a concern of the managers and of specific concern to the MSC (Marine Stewardship Council) who provided specific criteria for the management team to address in their certification. Slippage is discouraged but not prohibited, under any provision. Test tows are encouraged as a way to increase the accuracy of their tows. By using test tows, the vessel master is able to identify the likely composition of a school and decide based on that sample if the composition of that school is suitable for exploitation. The use of traditional hook and sinkers is also a method used by the midwater trawl fleet to determine the composition of the potentially-targeted school. The fleet also widely uses triple band sonar that more accurately determines the size of individual fish within a given school.

Regarding the mortality rate associated with slippage, and specifically the crowding of fish that occurs when the codend is brought to the surface, the Institute of Marine Research found that the mortality of mackerel that occurred after density of the fish on the surface reached flash expansion behavior or a “boil” was extremely high. Compared to their control that reached .1-46% mortality the mackerel that reached flash expansion behavior suffered 80%-100% mortality after being slipped. In conclusion of their research, they advised, in the event that slippage is inevitable, the vessel should make an effort to see that slippage occurs before the fish reach that critical boil.

5.1.6 Management

The Norwegian Herring fishery manages the North Sea Stock in conjunction with the EU-Norway Agreement. The agreement is implemented with advice from ICES by Norway. The National management system is composed of: The Norwegian Ministry of Fisheries and Coastal Affairs, The Norwegian Food Safety Authority, Institute of Marine Research, The Directorate of Fisheries, and The National Institute of Nutrition and Seafood Research.

The North Sea area is divided into two management areas that are then given area specific quota allocations. The national quota regulations are established every year in conjunction with ICES (International Council for the Exploration of the Sea). Individual quotas are given to vessels and are managed under a Structural Quota System (SQS) that allows quotas to be consolidated from

one vessel to be fished on another vessel as long as both vessels are owned by the same party. This can be temporary or permanent as long as one of the vessels is decommissioned. The basis for this system is to increase the economic efficiency of individual vessels and minimize fishery over capacity. This system also provides incentive for purchasing vessels for the purpose of consolidating quota on to one vessel. It also increases the transaction rate and encourages and accelerates the structural change within the fishery, which increases and decreases jobs on and off shore for the purpose of equity and efficiency.

When the catch is brought to port, the fish are sold by auctions and fishermen are paid according to the average size of the fish to reduce the incentives for high-grading. The purpose of this policy is to further discourage the incentives for discarding valuable catch.

5.1.7 Management Objectives

- 1. Every effort shall be made to maintain a level of Spawning Stock Biomass (SSB) greater than the 800,000 tonnes (Blim)*
- 2. Where the SSB is estimated to be above 1.3 million tones the Parties agree to set quotas for the directed fishery and for by-catches in other fisheries, reflecting a fishing mortality rate of no more than 0.21 for ringers and older and no more than 0.12 for 0-1 ringers.*
- 3. Where the SSB is estimated to be below 1.3 million tones the Parties agree to set quotas for the directed fishery and for by-catches in other fisheries, reflecting a fishing mortality rate equal to: $0.25 (0.15 * (1,300,000 - SSB) / 500,000)$ for 2 ringers and older, and $0.12 (0.08 * (1,300,000 - SSB) / 500,000)$ for 0-1 ringers.*
- 4. Where the SSB is estimated to be below 800,000 tonnes the Parties agree to set quotas for the directed fishery and for by-catches in other fisheries, reflecting a fishing mortality rate of less than 0.1 for 2 ringers and older and less than 0.04 for 0-1 ringers.*

5. *Where the rules in paragraph 2 and 3 would lead to a TAC which deviates by more than 15% from the TAC of the preceding year the parties shall fix a TAC that is no more than 15% greater or 15% less than the TAC of the preceding year.*
6. *Notwithstanding paragraph 5 the Parties may, where considered appropriate, reduce the TAC by more than 15% compared to the TAC of the preceding year.*
7. *By-catches of herring may only be landed in ports where adequate*

5.1.8 Shared Stock

The North Sea herring stocks are managed by a bilateral agreement between the EU and Norway. Every year, both parties meet with the purpose of agreeing on management measures of the shared resource for the following year. After the TAC is agreed upon, they distribute the shares of the quota to both governments.

5.1.9 Enforcement and Control

Catches are recorded by the skipper and entered into vessel logbooks that can be inspected by the Coast Guard at anytime. Vessels over 21m in Norwegian waters are subject to satellite based monitoring, in EU territory the requirement is above 15m. The vessels position is transmitted every hour to the Fisheries Directorate.

The chief tool used for transparency in the sales of raw fish, is with a contract note (landing receipt). The contract note is a sales slip that is electronically filled out when there is a landing, and includes the fish species, weight landed, and time of landing. The electronic slips are submitted in almost real-time, which provides a current accurate report of the industry. Roughly 200,000 forms are completed annually. The contract note is first received by the sales organizations then it is distributed to the Fisheries Directorate.

All landings are recorded and checked against their reported catch. The EU and Norwegian vessels that use refrigerated sea water tanks (RSWs) to contain their catch must carry onboard a

calibrated volume table that is checked and stamped by the member state were the vessel operates. This system has been used for 20 years and has been implemented in a way that is accurate between 2 -7%. Originally vessels were required to be within 20% of their estimation, but with this system they have reduced the uncertainty level to 10%.

A marine architect decides the vessels calibration when the vessel is close to completion, then an independent inspector certifies the calculations. In the event of a second-hand vessel, or a vessel that has not yet be calibrated, the holding tank is measured and calibrated by a marine architect and then verified by an inspector.

The total volume of fish in a tank is achieved by taking a piece of steel attached to a tape measure, when the weight rests on the fish, the measurement is noted and referenced in the calibration book. This process is then done with all the remaining fish holding tanks.

In 2006, the Coast Guard conducted 2185 inspections with 44 resulting in a report to the police and 27 resulting in arrest. The inshore inspections conducted by the Fisheries Directorate resulted in 1850 inspections with 155 reports to the police. (*statistics provided by the Fisheries Directorate*).

5.2 SCOTLAND

Target Species: Clupea Harengus

Fleet Size: 22 large pelagic vessels

Value of Catch: \$149 million in 2006

Certification: Marine Stewardship Council (MSC)

Utilization of Catch: Human Consumption

Stocks: Buchan, Banks, Downs

Date Achieving Maximized Retention: January 2010

Management: Limited Access Permits

Main Fishermen Organization: *Scottish Pelagic Sustainability Group (SPSG)*

The SPSG is an organization that is composed of fishermen, processors, and traders. The fleet is made up of 22 large pelagic vessels that prosecute the North Sea herring and the Western mackerel. The SPSG work with the regional fishery managers who, in turn, work under an international agreement between the European Commission, a Regional Advisory Committee (RAC) and Norway. They are all advised by the International Council for the Exploration of the Sea (ICES).

5.2.1 Monitoring & Compliance

There is a high degree of enforcement in this fishery which is the primary form of regulation to ensure compliance. All vessels are monitored with VMS tracking, aerial surveillance, and vessel patrol. There is also an at-sea observer program, but it does not seem to be a significant form of monitoring for the fishery.

Landings are almost 100% monitored via certified weight bridge. This also includes registration of buyers and sellers at designated landing ports. Although there is a high level of shore side monitoring, the fishery (international) has consistently overshoot its quota allotment: 16% in 2005 and 9% in 2006. The Scottish Pelagic Sustainability Group is not thought to contribute to this overshoot.¹²

5.2.2 Slippage

Slippage is not considered to be a significant issue because highgrading does not occur in this fishery. There are instances when the catch composition has a high mackerel content, but sometimes these diverse schools can be identified via advanced sonar. It is also understood that the beginning of the season has higher levels of slippage in an effort to catch the "right" fish. Slippage is not monitored, recorded and there have been no attempts to estimate the volume and composition of the slipped catches. All efforts are made to maximize the survival rate of the slipped catches.¹²

The Scottish Pelagic Sustainability Group states in its monitoring objectives:

The monitoring of fishing activities is an essential part of the sustainable policy of any fishery. The main goals and objectives of any fishery monitoring programme will generally be:-

- The collection of information on catch; bycatch; protected species; discards and wider environmental data which is used for management and stock assessment purposes.*
- The monitoring of fishing activity adherence to regulations governing the fishery.*
- The monitoring of fishing activity and effort to develop a better understanding of the operation of the fishery.*

At-sea observers offer one means of gathering independent, cost effective data, and may be used to reduce conflicts between stakeholders; concerns regarding over-exploitation and to provide a better understanding of how particular

¹² MSC Sustainable Fisheries Certification Programme. Final report for the Scottish Pelagic Sustainability Group Ltd North Sea Herring. Food Certification International. 2008

fisheries work. Whatever their motivation for use, they should provide outputs that contribute to the development of international management measures that encourage good fishing practices and promote both stock and fishery sustainability. To this end the Scottish pelagic industry supports their use as one means to provide this assurance and information, and will work with industry agencies, bodies and industry groups to facilitate such programmes where considered appropriate.

The Scottish pelagic fleet already has strong relationships in this field with the FRS Marine Laboratory and Sea Mammal Research Unit, St Andrews University and will cooperate and comply with monitoring programmes put in place to ensure that these goals can be met in line with cooperation provided by fishermen from other nations fishing pelagic stocks in the North East Atlantic. It is recognised that monitoring programmes help to provide evidence and demonstrate compliance of conservation, mitigation and technical measures in place for the management of the fishery. Therefore, when appropriate the industry will help establish, in consultation with relevant regulatory agencies, bodies and industry groups; effective monitoring systems to record and evaluate adherence to sustainable principles and practices.

A pelagic inspection protocol governing the inspection and monitoring procedures for pelagic processing plants has been agreed between Scottish Fishery Protection Agency and most of the pelagic processing industry. It is understood that the provisions of this protocol will be implemented throughout the entire industry. This is essential to ensure widespread and total confidence in the pelagic monitoring and compliance regime.

5.2.3 Landings

The Scottish Pelagic Sustainability Group can only land its fish to buyers who are registered and in compliance with the Scottish Executive. To be in compliance, the buyer must agree to keep accurate records of their transactions, as well as be open to inspections by the Scottish Fisheries Protection Agency at any time. This including the regulations on the catch sector extends management control throughout the supply chain.

5.2.4 Maximized Retention and Discarding

The current management plan for the Scottish Pelagic Sustainability Group states that:

"The deliberate discarding of a haul in order to seek a more commercially viable catch in future fishing activity; or to discharge a catch overboard in order to free stowage capacity for fish of a

higher marketable value is unacceptable except where necessary to comply with minimum landings size regulations. The Scottish pelagic industry does not and will not condone this activity. Slippage or highgrading contradicts the whole spirit of the sustainable policy under which the industry operates. Scottish pelagic vessels do not carry grading equipment.¹³"

According to the MSC sustainability report, there is little discarding of fish at sea, and the equipment set up on deck makes it difficult, but not impossible. The fish that are caught in the codend are pumped out and sent through a dewatering system that then dumps the fish into the refrigerated sea water (RSW) tank. There is no sorting equipment on deck for discarding. It is technically possible to pump the fish out of the hold while out at sea, like they do at dock, but it is considered unusual and is also illegal. "all bycatch is required to be landed and counted against the quota, and there are penalties for over quota fish."¹⁴

According to an article in Fishupdate published July 14, 2009, beginning January 2010, a discard ban will be implemented for mackerel, herring and horse mackerel. This ban will make high grading for higher value fish illegal. It will be seen how enforcement and compliance is obtained. It is suggested that video monitoring aboard all pelagic vessels is required to ensure compliance.

¹³ Scottish Pelagic Sustainability Group Ltd. <http://www.scottishpelagicsg.org>

¹⁴ MSC Sustainable Fisheries Certification Programme, Final report for the Scottish Pelagic Sustainability Group Ltd North Sea Herring. Food Certification International. 2008

5.3 UNITED STATES

Pacific Whiting Shoreside Fishery

Vessel Type: Midwater trawl

Fleet Size: 37

Species: *Merluccius productus*

Utilization: Human Consumption

Management: Limited Access, soon to be IFQ in 2011

Shoreside Fleet Size: 26-29

Mothership Processor Fleet Size: 4-6

Mothership Catcher Vessel Fleet Size: 11-20

*Many shoreside vessels serve as mothership catcher vessels

Catcher Processor Fleet Size: 5-9

2008 Landings (mt): 248,000

2008 Ex-Vessel Value: \$63 million

2009 OY for Shoreside Whiting (mt): 135,939

Cost of Monitoring to Industry and NMFS: \$293,050. 2.6% of the ex-vessel value of the fishery

5.3.1 Policy Impetus

Due to the industry's need to refrigerate whiting as quickly as possible after loading, because of the delicate nature of the meat, catchers preferred to place all catch in the hold and sort the fish at the dock. "Pacific whiting deteriorates rapidly, so it must be handled quickly and immediately chilled to maintain product quality.¹⁵" By necessity, they were practicing full retention, but under regulation all industry is not permitted to retain protected species such as salmon. The result was the establishment of an excluded fishing permit or EFP. "EFPs allow vessels to engage in activities that are otherwise illegal for the purpose of collecting information that may lead to a management decision or to address specific environmental concerns.¹⁵"

5.3.2 Management

The Pacific whiting fishery is regulated under the Groundfish FMP but is under a "primary" season structure allowing harvest until their allocation is reached. The rest of the groundfish sector, not including the non-tribal commercial fishery, is currently under a "trip limit" structure that limits per gear type, species, and the amount of fish that can be landed that trip. Due to the number of overfished species such as widow, canary, and darkblotch rockfish, bycatch limits have been established to allow the industry the ability to increase their harvest as long as the number of overfished species are kept within their limits. Currently, the groundfish trawl fishery has roughly 140 permits, which includes non-whiting and whiting sectors.

¹⁵ A Maximized Retention and Monitoring Program For the Pacific Whiting Shoreside Fishery. Draft Environmental Assessment by the Pacific Fishery Management Council. 2007.

Ex-vessel Value of Pacific Whiting in the Shore-based Sector 1997-2008

| Year | Number of First Receivers | Number of Catcher Vessels | Average annual ex-vessel price per pound (\$) | Total catch of Pacific whiting (mt) | Ex-vessel value of Pacific whiting, all vessels (\$) | Ex-vessel value of Pacific whiting, average per catcher vessel (\$) |
|------|---------------------------|---------------------------|---|-------------------------------------|--|---|
| 1997 | 12 | 41 | 0.042 | 87,499 | 8,101,812 | 197,605 |
| 1998 | 12 | 36 | 0.021 | 87,627 | 4,056,832 | 112,690 |
| 1999 | 14 | 39 | 0.036 | 83,388 | 6,618,139 | 169,696 |
| 2000 | 14 | 36 | 0.040 | 85,653 | 7,553,224 | 209,812 |
| 2001 | 13 | 29 | 0.036 | 73,326 | 5,819,562 | 200,675 |
| 2002 | 8 | 30 | 0.045 | 45,276 | 4,491,696 | 149,723 |
| 2003 | 9 | 33 | 0.045 | 51,061 | 5,065,609 | 153,503 |
| 2004 | 9 | 26 | 0.035 | 89,251 | 6,886,696 | 264,873 |
| 2005 | 10 | 29 | 0.052 | 97,378 | 11,163,336 | 384,943 |
| 2006 | 14 | 37 | 0.062 | 97,296 | 13,298,923 | 359,430 |
| 2007 | 14 | 39 | 0.070 | 878,398 | 13,487,434 | 345,832 |
| 2008 | 16 | 37 | 0.102 | 50,423 | 11,338,580 | 306,448 |

5.3.3 Policy Development

After the scoping process, it was determined that full retention and monitoring options not only addressed the incidental catches of salmon, but that it served as a measure to reduce bycatch, improve data collection, and track many aspects of the fishery previously unknown. In the scoping process, the PFMC found many issues with developing a comprehensive catch monitoring and maximized retention program. Stakeholders collaborated and compiled their concerns in preparing Amendment 10 creating a summary in the Draft EA which is described below:

5.3.3.1 Full/Maximized Retention

While considering maximized retention, the PFMC evaluated the merits of the policy, as well as came up with a clear definition of what full retention was in relation to the pollock fishery. They also recognized that there needed to be an allowance for sorting catch at sea. Since EFPs have been issued to the fishery on a yearly basis, it has been in the interest of the stakeholders to develop a more effective and specific policy for retaining protected species. The importance of having industry support for a monitoring program was discussed as well as the need to verify catch shoreside in addition.

5.3.3.2 Monitoring

While developing the monitoring requirements for the fishery they came up with a list of clearly stated goals, of which, consistency, clarity, monitoring levels and resource use were important themes.

- The need to have clearly defined objectives for the monitoring program
- The need for the monitoring program to be built on the existing EFP infrastructure
- The need for consistency across states
- Resources available to implement a monitoring program differ by state
- The need for appropriate monitoring levels
- Allowing discard at sea would require observers to be aboard the vessels
- Using Federal observers on catcher vessels is an inefficient use of resources
- The Logistic of port sampling is difficult/unusual for NMFS's WCGOP (West Coast Groundfish Observer Program)
- Implementation of a monitoring program must be appropriate with IFQs
- Having Pacific States Marine Fish Commission (PSMFC) administer a NOAA directed observer program
- How the need for industry samplers changes
- If weighmasters are appropriate

5.3.3.3 EMS

While developing the goals of their electronic monitoring system, the PFMC highlighted several important factors such as:

- Letting vessel owners/operators have access to their EMS images
- Insurance and liability concerns for industry with video cameras
- The need to protect vessel owner/operators
- The need to address data confidentiality and privacy rights
- The adequacy of EMS testing for supporting a rulemaking
- The need to have more than one company providing EMS services
- The failure rate of EMS
- The time it takes to do analysis

5.3.3.4 Overages

- The need to ensure that overages are handled appropriately
- The need for port-specific market values of overage fish

5.3.3.5 Recordkeeping and Reporting

- The ability to track bycatch with an audit process
- The ability to audit logbooks for discard
- The need for almost real-time data to monitor bycatch limits
- The applicability of current paper logbooks for this fishery
- The need to have a way to correct fish tickets
- If program includes electronic fish ticket, there is a need to meet the requirements of all three states
- Processors need to have a specific person responsible for bycatch accounting

5.3.3.6 Costs

The costs associated with the PFMC MR program can be considered high, so the equity of the program must be analyzed as well as the various funding mechanisms available.

- The need for improved cost estimates
- The cost to the fishery of full retention monitoring program
- The costs relative to the economic importance of the fishery to each state
- The inclusion of Federal, State, and/or Industry funding options
- The shore-based Pacific whiting fleets ability to fund a monitoring program

5.3.3.7 Other

Along with the standard factors that must be taken into consideration, the PFMC identified several other key components that they wanted to research that were mostly specific to the whiting fishery.

- The use of Pacific whiting shoreside fishery bycatch caps
- The use of individual vessel bycatch caps
- The possible use of a "penalty box" system
- The importance of the States and industry to be involved in the process
- The need to accommodate the early California fishery
- The use of permit endorsements

Under the current Groundfish FMP up to Amendment 19, Amendment 10 provided the necessary groundwork to convert the EFP that allowed the retainment of protected or over fished species, and their at sea reporting requirements, to a formal rule making. (Groundfish FMP, 2009)

5.3.4 Alternatives

The Pacific Groundfish Committee initially proposed five alternatives, based on the information gathered in their scoping process. Two alternatives were removed in the decision making process which left three primary alternatives.¹⁶

Alternative 1 (No Action): Trip Limit Regime

Management Structure: Under this alternative no EFPs would be issued and the management of the Pacific whiting shorebased fishery would revert to a trip limit regime for non-whiting groundfish species. All catch would be required to be sorted at sea, as is currently required by regulation. Vessels using midwater trawl gear in the Pacific whiting shoreside fishery would be subject to prohibitions specified at 50 CFR 660.306 (a)(2) and (6), and 50 CFR 660.405 (a)(1), which prohibit the retention of prohibited species as defined at §§ 660.302 and 660.370 (e), and prohibit the retention of groundfish in excess of cumulative trip limits.

Federal Permits, Endorsements, and Certifications: A Pacific Coast groundfish limited entry permit with a trawl endorsement would be required to participate in the fishery. When Amendment 15 is implemented, a Pacific whiting vessel license would also be needed.

Recordkeeping and Reporting: Federal regulations at 50 CFR 660.303 would continue to require vessels to make and/or file, retain, or make available any and all reports (i.e., logbooks, fish tickets, etc.) of groundfish harvests and landings as required by the applicable state law.

Monitoring Shore-based Catcher Vessels At Sea: The WCGOP would be responsible for providing at-sea observer coverage for Pacific whiting shoreside vessels as specified at 50 CRF 660.314 (c)(2). When notified by NMFS of any requirement to carry an observer, the regulations at 50 CFR 660.303 (i)(5) prohibit a vessel from taking and retaining, possessing, or landing any groundfish without a WCGOP observer.

The sampling priorities for WCGOP observers deployed to trawl vessels are to collect data that are used for total catch estimates of each groundfish species or species group over the entire fishing year, and to collect fishery dependent biological data that are otherwise not available on shore. The WCGOP sets coverage priorities for different fisheries and fleets that comprise the groundfish fishery. Observers are deployed on vessels in the active sampling unit or pool of

¹⁶ A Maximized Retention and Monitoring Program For the Pacific Whiting Shoreside Fishery. Draft Environmental Assessment by the Pacific Fishery Management Council. 2007.

vessels selected for coverage. Vessels in the pool are generally selected at random. The proportion of a particular fishery or fleet that receives observer coverage is based on the WCGOP coverage plan. Although the WCGOP strives for a 20 percent coverage level of vessels in the bottom trawl fisheries, it is likely the Pacific whiting shoreside fishery would be given a lower coverage priority when considering: 1) the data needs of the Pacific whiting fishery relative to the total catch data needs for the entire groundfish fishery, 2) the limited number of observers available to be deployed, 3) current data available from other sectors of the Pacific whiting fishery, and 4) the availability of historical data that can be factored in to catch estimates.

Monitoring First Receivers: Each state would continue to hire, train, and pay for port biologists to: collect fish ticket data; complete landing summaries; and, to collect biological data. **Disposition of Overage Fish:** Under this alternative there are no allowances for landing legal overages in excess of the trip limits. Therefore, all overage fish would need to be discarded at sea.

Alternative 2

Under Alternative 2, EMS coverage would be required on all trips to assure that catch is retained until landing. Because full EMS coverage reduces the likelihood of catch being discarded at sea, the opportunity to conduct accurate shoreside catch accounting of all species would be improved over the No Action Alternative. Under Alternative 2, onshore catch accounting would be conducted bycatch monitors. Pacific whiting shoreside first receivers would be required to procure the services of a single catch monitor from a NMFS-specified service provider. If a catch monitor was unable to monitor all deliveries, they would randomly select deliveries to monitor for fish ticket verification.

Because the primary objective of catch monitoring is to conduct fish ticket verification, catch monitor would oversee the sorting and weighing of all the incidental catch in as many deliveries as possible with the primary goal being verification of incidental catch weights and salmonids. The number of deliveries that can be monitored by an individual catch monitor is limited by factors such as: the number of deliveries received in a day, the time each delivery takes to be sorted and weighed, the process of how the catch is sorted, and the weighing process. Depending on a first receiver's capacity and efficiency, and the size of vessel deliveries, a full offload could take a few hours to the majority of the day. To provide accurate fish ticket verification of the target species, a large proportion of all deliveries would need to be monitored. To accurately monitor rare occurring species, a large proportion of each individual delivery would also need to be monitored.

With one catch monitor per first receiver, it is reasonable to expect that 100 percent of the days that fish are received would be monitored. However, within each day the proportion of individual deliveries that could be monitored by a

single catch monitor would vary between first receivers. At some facilities, a catch monitor could monitor all deliveries. Because of physical limitations of using a human monitor, it is not reasonable to expect a catch monitor to regularly work more than 12 hours per day (11 hours monitoring plus one hour of paperwork) or to have less than a 6 hour break after a 12 hour shift. At smaller facilities (those at which the offloading, sorting and weighing process take less than 12 hours per day) and trucking operations a single catch monitor would likely be able to monitor all deliveries or nearly 100 percent. At larger facilities, (those that offload, sort, and weigh catch more than 12 hours per day) or those that offload, sort and weigh catch from more than one vessel at a time a single catch monitor would be required to randomly monitor a sub group of all deliveries.

Under Alternative 2, if catch reporting issues are identified during the season, the catch monitor would provide data that could be used to modify catch values. Having the ability to make corrections inseason improves the quality of data used to monitor the attainment of fishery specifications. However, having only a portion of the hauls directly monitored limits the ability to adjust catch values inseason and would primarily be limited to monitored deliveries. The potential risk a fishery specification being exceeded is less under Alternative 2 than under the No Action, but more of a risk than under Alternative 3.

Alternative 3:

Like Alternative 2, Alternative 3 would require EMS coverage on all trips to assure that catch is retained until landing. Because full EMS coverage reduces the likelihood of catch being discarded at sea, the opportunity to conduct accurate shoreside catch accounting of all species would be improved over the No Action Alternative, but would be the same as Alternative 2.

Under Alternative 3, on shore monitoring would be conducted on shore bycatch monitors. Pacific whiting shoreside first receivers would be required to procure the services of enough catch monitors to provide full coverage of every delivery from a NMFS-specified service provider. Beginning in 2009, sector-specific bycatch limits for overfished species will be used allow each sector of the whiting fishery to be closed when the bycatch limit is projected to be attained. Bycatch limits are used to reduce the risk of exceeding a specified bycatch limit and possibly an overfished species OY. To insure the integrity of sector-specific bycatch limits, the Council recommended full catch monitor coverage in which all Pacific whiting deliveries beginning in 2009. With full coverage, the number of individual catch monitors per facility would vary depending on the hours of operation and the number of Pacific whiting deliveries received each day. This is compared to the No Action Alternative in which there would be no mechanism for fish ticket verification on shore, and Alternative 2 where a subset of the deliveries would be monitored.

Alternative 3 has the greatest potential for providing the most accurate data.

When considering the alternative coverage levels, full catch monitor coverage would provide the most accurate data on bycatch limit and rare occurring species. As discussed above, exceeding a fishery specification is of greatest concern for the most sensitive overfished species. Because of this, the risk of a fishery specification being exceeded is lowest under Alternative 3. Having the ability to verify that all catch is being brought to shore where accurate accounting can occur, is a substantial benefit over sorting the catch and discarding unmarketable species and overages at sea (No Action). If catch reporting issues are identified during the season, the catch monitor would provide data that could be used to modify catch values on any delivery.

5.3.5 Catch Monitoring

To ensure compliance with the maximized retention program, NMFS in 2004 contracted Archipelago to implement an electronic monitoring system on all vessels in the Pacific Whiting Shoreside fishery. The electronic set-up consists of multiple cameras, GPS, data storage device, and a winch and hydraulic sensor that turns the system on to monitor landings.

In the initial stages of the program there were issues with obstruction and unplugging the cameras in fear of shutting the fishery down due to the low quota allocations for protected species. Solutions to that problem included removing the plugs associated with the cameras to make them tamper proof, and to arrange the cameras in a way that provided optimal visibility while ensuring obstruction was not feasible.

Before the catch is landed the vessel must call into NMFS and notify them of which of the three processing plants they are arriving at to ensure an on shore observer is present to monitor the catch. There are additional locations where the vessels can offload, but there must be an observer present, and able to follow the catch to the processing plant.

The accounting of quota is real-time, and allows for up-to-date accounting for all quotas and caps. It also allows for immediate action by NMFS to control area closures and alert the fleet of areas with high concentrations of bycatch.

When a bycatch quota is reached NMFS has two options, they can first restrict the depth of fishing, which is a control rule that works for most protected fish whose distribution amongst

varying water columns is limited. For species that are distributed amongst varying depths, this is not an option for bycatch reduction. The final option is to close down the fishery.

5.3.6 Bycatch

Catch that is landed with limited entry vessels for which they do not have quota for, either protected species or overages, gets processed and sold, and the proceeds are given to the state. Protected species that cannot be sold, like salmon and haddock, are donated to food banks and homeless shelters. The specific program is determined by state and by port. The key elements to this program are that overages are not incentivized by profit. Non-sellable fish is donated and not wasted, and industry processes all consumable fish, for the State or industry's benefit.

Along with Amendment 20 of the groundfish plan to implement an IFQ fishery is the plan to rationalize the groundfish fishery. The way they plan on achieving this is by combining the whiting and non-whiting shoreside fishery into one plan. This will expand the current coverage of the monitoring and maximized retention program into the non-whiting sector, expanding the scale of this program.

5.3.7 Costs

Estimated costs of EMS to Industry and NMFS

| Direct Costs of EMS to NMFS | Alternatives 2 and 3 |
|--|-----------------------------|
| Outreach | \$17,755 |
| EMS equipment | \$0 |
| Installations/removals | \$0 |
| Service | \$0 |
| Review and cataloguing of data and video imagery | \$23,500 |
| Analysis and final report | \$35,635 |
| Certification program for EMS providers | \$0 |
| Staff training on analyzing EMS data | \$12,644 |
| TOTAL | \$89,534 |
| Direct Costs of EMS to Industry | |
| Outreach | \$0 |
| EMS equipment | \$151,970 |
| Installations/removals | \$71,380 |
| Service | \$46,200 |
| Review and cataloguing of data and video imagery | \$23,500 |
| TOTAL | \$293,050 |

The cost of the monitoring program to the Oregon and Washington states in 2003 was about \$70,327, roughly \$40,519 for coordination and data processing, and about \$29,808 for samplers. Federal government costs are not included in this estimate.¹⁷

¹⁷ Wiedoff, B., Conrad, J. & Parker, S. 2003. Shoreside Hake Observation Program 2003.

5.4 BRITISH COLUMBIA

Groundfish Fishery

Number of Vessels: 301

Amount of Landings (mt): 104,564

Ex-vessel Value of Landings: \$138,736,622

Utilization: Human Consumption

Number of Stocks: 60+

Number of Unloading Locations: 30

Management: Individual Vessel Quota (IVQ)

At-sea Observer Funding: Industry 70% and Government 30%

Electronic Monitoring Funding: 100% Industry

Fishery Operations System (FOS) Funding: 100% Government

5.4.1 Policy Impetus

The British Columbia Groundfish Fishery IVQ and full accounting fishery was brought about because of an increasingly complex management system that made it very difficult to calculate quotas and subsequently high levels of discarding due to the interconnectivity of the various groundfish species. By going to an IVQ, they were able to create a managing system that had more accurate accounting of bycatch as well as accountability for subsequent catches with real-time quota tracking. Electronic monitoring and observer coverage has been provided by a third

party consulting company to provide neutrality with an “arms length away” approach for the Industry and Government.

5.4.2 Full Accounting

The B.C. Groundfish fishery is not a maximized retention fishery, but rather a full accounting fishery, where all fish that is discarded is counted towards the vessels’ quota. This incentivises the retainment of sellable fish by not having it count against their quota, but gives the vessel freedom to discard if economically feasible or if safety is a concern. Full accounting with electronic monitoring requires visual identification of species and weight estimates to allow for accurate accounting of discards.

5.4.3 Monitoring and Compliance

Catch monitoring is achieved in three ways: first, there is 100% dockside monitoring by certified governmental observers; second, there are electronic monitoring systems that are strategically located on the vessels to monitor catch; and/or finally, there is the option to bring aboard an observer.

Dockside monitoring is achieved with 100% coverage by limiting the landing locations to 30 designated spots coast-wide. The landings are organized by species, and then weighed or counted on government certified scales. After the catch has been sorted the dockside monitor records the numbers and the data is sent in along with the vessel-offloading log to the government for entry in to the Fishery Operation System (FOS).

5.4.4 Management

Since 1997, the B.C. groundfish fishery trawl sector has been managed by an Individual Vessel Quota (IVQ). In 2005, the management plan was expanded to include the hook and line sector of the fishery. The IVQ system has been contingent on two key management components, 100% monitoring coverage and up to date, accurate, accounting of catch in order to ensure compliance and to effectively monitor quotas.

5.4.5 Costs

The costs of the monitoring program are distributed amongst the industry and the government. Industry pays for 100% of the dockside monitoring cost, hauls, and 70% of the at-sea monitoring costs. The government is responsible for 100% of the fishery operations system (FOS) and 30% of the at sea monitoring costs.

| FISHERY | Average Cost per Unit | | | | | Average Cost per Landed Pound | | | | | % Fishery Value |
|----------------|-----------------------|-------------|------------|------------|-----------|-------------------------------|----------|----------|----------|----------|-----------------|
| | Cost / Vessel | Cost / Trip | DMP / Trip | ASOP / day | EMP / day | BDC | DMP | ASOP | EM | Total | |
| BC Groundfish | | | | | | | | | | | |
| Hook and Line | \$10,655 | \$1,618 | \$425 | | \$154 | \$0.0020 | \$0.0240 | | \$0.0660 | \$0.0910 | 3.05% |
| Bottom Trawl | \$64,058 | \$3,897 | \$490 | \$558 | | \$0.0005 | \$0.0050 | \$0.3300 | | \$0.0380 | 7.58% |
| Midwater Trawl | \$13,173 | \$589 | \$340 | | \$107 | \$- | \$0.0020 | | \$0.0010 | \$0.0040 | 3.71% |

PFMI 2009

5.4.5.1 Dockside Monitoring Program Costs

- \$72 per hour charge out rate for monitoring trawl offloads, \$113 per hour for monitoring hook & line and trap offloads, and 15¢ per halibut tag

5.4.5.2 At-Sea Observers

- \$567/day for a government certified at-sea observer (divided 30/70, government pays \$202/day and the vessel pays \$365/day)

5.4.5.3 Electronic Monitoring

The pricing structure for the electronic monitoring equipment has been divided into three categories to facilitate easy integration regardless of financial capability at the time of purchase.

- \$55/day rental for entire custom design weather and tamper proof system – includes keyboard, monitor, CPU, 2 cameras, hydraulic pressure transducer, winch sensor, and GPS receiver

- \$45/day rental for keyboard and CPU if vessel owner has purchased the peripherals (cameras, sensors, monitor - cost of \$2000)
- \$8950 to purchase entire system

They also implemented a rent to purchase plan where 95% of rental fee is applied against purchase price to more readily facilitate ownership of the technology.

5.4.5.4 Installation and Analysis fees

- \$36/hr servicing fee for installation, removal and repairs (average installation is 2-3 hours, average removal is 1 hour)
- \$36/hr for analysis of logbook, imagery, and sensor data (analysis time ranges from 2 – 8 hours depending on trip length, # of sets and measurements, species diversity and quality of data)

While designing the program, the managers made their decisions based on several concerns – funding pressures, the high cost of monitoring programs and data management systems, how to distribute the high costs during transition (start up costs) and eventually how to divide the ongoing costs, create a step by step approach to reduce financial impact on fishermen, and finally making sure the industry is involved with the design process to ensure efficiency and cost effectiveness.

5.5 BRITISH COLUMBIA

Area A Crab Fishery

Number of Vessels: 50

Number of Traps: 36,000

Species: *Cancer magister*

Utilization: Human Consumption

2008 Volume of Catch (mt): 4,629

2003 Ex-vessel Value of Fishery: \$22 million

Main Fishermen Organization: Area A Crab Association

Management: Trap Limit

Cost: \$10CDN per trap, \$72,000CDN per vessel, 16% of the ex-vessel value of the fishery

The Area A Crab Association is an example of electronic monitoring being used solely for compliance and enforcement. I have included this example in this paper because the program was developed by the Government and Industry and has been regarded as a success for both the fishermen and the fishery managers.

5.5.1 Policy Impetus

During the 1990's, the Canadian Dungeness crab fishery experienced a tremendous increase in fishing effort, fleet size, and number of traps. Exceeding a total of 50,000 traps, the fishery was exceeding the sustainability of its stocks and consequently increasing the competition amongst

fishermen. The lack of enforcement and regulation was evident with many boats fishing other vessel's traps, stealing the catch without permits. The result was in estimated losses per fishermen of about CDN \$100,000 annually.

In an effort to resolve the chaotic state of the fishery, in 2000, the fishery regulators set a goal to limit the number of total traps to less than 36,000. To do this, they permitted traps to vessels based on vessel size, allocating between 600 and 1,200. Managers needed to be able to monitor and enforce this regulation, as well as identify individual traps to ensure compliance¹⁸.

5.5.2 Electronic Monitoring

In developing an electronic monitoring system, Archipelago worked with the Area A Crab Association to find an affordable and effective solution.

The first thing that was devised was a Radio Frequency Identification (RFID) system that individually tracked trap buoys when a trap was set and hauled back. Every time a trap passes over the rail of the vessel, a built in scanner reads the individual tag of that trap and records the data in the vessels electronic log to be cross-examined with data recorded by other monitoring systems onboard the vessel.

The next thing that was required was a system that would ensure that fishing was occurring legally, whether that was manipulating traps, buoys, etc, or hauling other vessels traps. Area A Crab Association and Archipelago developed a camera and winch monitoring system that would monitor deck activity.

5.5.3 Cost

Annual cost is about \$10CDN per trap, about \$360,000CDN, or less then 20% of at-sea observer costs for that fishery. This breaks down to, on average \$72,000CDN per vessel, with vessels making on average \$440,000CDN annually. Depending on the vessel, monitoring provided a savings of about \$28,000CDN, based on the loss estimate of \$100,000CDN reported by

¹⁸ Archipelago Marine Research Limited. *BC Area A Crab Fishery*. <http://www.archipelago.ca/highlight.aspx?ID=CF3EA83A-DB53-4F69-B787-3F7AEF432C2B>. Date Retrieved August 3, 2009

Archipelago¹⁹. The cost of the monitoring program equates to about 16% of the ex-vessel value of the fishery.

Area ‘A’ Crab Fishery Fee Schedule²⁰

| 2009 Allocation | Monitoring Base rate | GST 5% | Association Dues | Total |
|------------------------|-----------------------------|---------------|-------------------------|--------------|
| 533 traps | 4,026.00 | 201.30 | 3,080.00 | \$ 7,307.30 |
| 710 traps | 4,768.00 | 238.40 | 4,040.00 | \$ 9,046.40 |
| 888 traps | 5,510.00 | 275.50 | 5,000.00 | \$ 10,785.50 |
| 1065 traps | 6,252.00 | 312.60 | 5,960.00 | \$ 12,524.60 |

5.5.4 Enforcement

The monitoring services are provided by the Area A Crab Association, who several requirements for membership and service. First, monitoring device must be continuously on during a fishing trip. Second, interference with sensors is prohibited. Finally, each trap must be scanned. Repeated violations can result in suspension of monitoring service, which then will be revoked and the fishermen will need to individually provide their own monitoring service, which would be extremely costly. Ultimately it is reported that there is more cooperation amongst fishermen.

6.0 CONCLUSION

Many fisheries have utilized enhanced catch monitoring programs as well as maximized retention in an effort to reduce the numbers of bycatch and to realize financial benefits to Industry and Government. Although brought about by a variety of issues and problems, MR policies have been used to achieve several key objectives. To the benefit of fishery managers and Industry, they have seen increased catch data, which has resulted in increased accuracy in quota allocations. Environmental groups have supported MR and catch monitoring because it encourages a higher level of scientific data gathering and monitoring with increased understanding of fishing mortality and environmental impact.

¹⁹ Archipelago Marine Research Limited. *BC Area A Crab Fishery*. <http://www.archipelago.ca/highlight.aspx?ID=CF3EA83A-DB53-4F69-B787-3F7AEF432C2B>. Date Retrieved August 3, 2009

²⁰ Area ‘A’ Crab Fishery Fee Schedule. 2009.

The success of maximized retention in its various forms has been contingent on thorough design and implementation, making sure all stakeholder are active in the development of these programs, like the Pacific Fishery Management Councils development of Amendment 10, may ensure more successful, agreeable and cost effective design to suit that fisheries needs. It is also an ongoing process like the British Columbia Groundfish Fishery and the Norwegian Herring Fishery that has invested many years in refining and developing an optimal system for the current management needs.

When evaluating the feasibility of MR and or catch monitoring programs for the New England Atlantic Herring fishery, there will be many unique obstacles and opportunities that may not have been encountered in other fisheries, it is important to remember that the goal of maximized retention and catch monitoring is to create a fishery that minimizes its waste, realizes more profit, and promotes environmental stewardship. Maximized retention and catch monitoring are two policies that can be mutually exclusive but when utilized in conjunction with each other they can provide the greatest net benefit. If going the route of implementing one policy before another, accurate catch monitoring should precede maximized retention due to the enforcement requirements of maximized retention. Catch monitoring may also provide information that could benefit the development of a more precise maximized retention policy. Certainly there are many reasons not go down the road of maximized retention and catch monitoring, such as costs, and certain complexities like dockside monitoring, but the potential benefits brought about by higher levels of monitoring and sampling coverage, may improve the fishery for all stake holders making this an important option for thorough consideration and potential development.

Appendix I

Conversions used for calculating the tonnage of catch from the specific density of the fish. Used for calculating the tonnes of fish in any specific fish hold. Developed in Norway.

Herring per cm² x .82 (ie 100 cm² = 82 tonnes of herring)

Mackerel per cm² x .72 (ie 100 cm² = 78 tonnes of mackerel)

Appendix II

A working document from the Scottish Pelagic Sustainability Group regarding maximized retention.

| RSW(refrigerated salt water tanks) | | FREEZERS | |
|---|---|---|---|
| Trawl | Purse Seiners | Trawl | Purse Seiners |
| Regulatory measures | | | |
| Extend the geographical coverage of the ban on highgrading | Extend the geographical coverage of the ban on highgrading | Extend the geographical coverage of the ban on highgrading | Extend the geographical coverage of the ban on highgrading |
| No minimum landing size | No minimum landing size | No minimum landing size | No minimum landing size |
| <i>Proposal to remove minimum landing size for herring, mackerel and horse mackerel through out the geographical area</i> | <i>Proposal to remove minimum landing size for herring, mackerel and horse mackerel through out the geographical area</i> | <i>Proposal to remove minimum landing size for herring, mackerel and horse mackerel through out the geographical area</i> | <i>Proposal to remove minimum landing size for herring, mackerel and horse mackerel through out the geographical area</i> |
| Sample/Trial fishing | Sample/Trial fishing | Sample/ Trial fishing | Sample/Trial fishing |

| | | | |
|--|--|--|--|
| <i>Encourage vessels to assess the size and composition of the target shoal before commencing the commercial fishing operation</i> | <i>Encourage vessels to assess the size and composition of the target shoal before commencing the commercial fishing operation</i> | <i>Encourage vessels to assess the size and composition of the target shoal before commencing the commercial fishing operation</i> | <i>Encourage vessels to assess the size and composition of the target shoal before commencing the commercial fishing operation</i> |
| Move on provisions/ Minimum catching size | Move on provisions/ Minimum catching size | Move on provisions/ Minimum catching size | Move on provisions/ Minimum catching size |
| <i>Self imposed requirement for a vessel to change fishing grounds by a distance of [10 n.m.] for a minimum period of [24 hours] if more than 10% of the catch is below an agreed minimum size or permitted catch composition</i> | <i>Self imposed requirement for a vessel to change fishing grounds by a distance of [10 n.m.] for a minimum period of [24 hours] if more than 10% of the catch is below an agreed minimum size or permitted catch composition</i> | <i>Self imposed requirement for a vessel to change fishing grounds by a distance of [10 n.m.] for a minimum period of [24 hours] if more than 10% of the catch is below an agreed minimum size or permitted catch composition</i> | <i>Self imposed requirement for a vessel to change fishing grounds by a distance of [10 n.m.] for a minimum period of [24 hours] if more than 10% of the catch is below an agreed minimum size or permitted catch composition</i> |
| <i>Following inspection requirement for all vessels to change fishing grounds by a distance of [10 n.m.] from the position of the inspection for a minimum period of [24 hours] if more than 10% of the catch is below an agreed minimum size or permitted catch composition</i> | <i>Following inspection requirement for all vessels to change fishing grounds by a distance of [10 n.m.] from the position of the inspection for a minimum period of [24 hours] if more than 10% of the catch is below an agreed minimum size or permitted catch composition</i> | <i>Following inspection requirement for all vessels to change fishing grounds by a distance of [10 n.m.] from the position of the inspection for a minimum period of [24 hours] if more than 10% of the catch is below an agreed minimum size or permitted catch composition</i> | <i>Following inspection requirement for all vessels to change fishing grounds by a distance of [10 n.m.] from the position of the inspection for a minimum period of [24 hours] if more than 10% of the catch is below an agreed minimum size or permitted catch composition</i> |
| Closed areas | Closed areas | Closed areas | Closed areas |
| <i>An area established by the moving on provisions which is closed for all pelagic vessels</i> | <i>An area established by the moving on provisions which is closed for all pelagic vessels</i> | <i>An area established by the moving on provisions which is closed for all pelagic vessels</i> | <i>An area established by the moving on provisions which is closed for all pelagic vessels</i> |
| | | Land all by-products/waste | Land all by-products/waste |
| Incentive schemes | Incentive schemes | Incentive schemes | Incentive schemes |

| | | | |
|---|---|---|---|
| Nationally administered schemes to give credit to those fishermen who use equipment such as flowmeters or CCTV or who carry observers on board. | Nationally administered schemes to give credit to those fishermen who use equipment such as flowmeters or CCTV or who carry observers on board. | Nationally administered schemes to give credit to those fishermen who use equipment such as flowmeters or CCTV or who carry observers on board. | Nationally administered schemes to give credit to those fishermen who use equipment such as flowmeters or CCTV or who carry observers on board. |
| Segmentation of quota by size grade | Segmentation of quota by size grade | Segmentation of quota by size grade | Segmentation of quota by size grade |
| Technical measures | | | |
| Maximum space between bars in the water separator | Maximum space between bars in the water separator | Maximum space between bars in the water separator | Maximum space between bars in the water separator |
| Certified drawings (GA) of the vessels and any modifications | Certified drawings (GA) of the vessels and any modifications | Certified drawings (GA) of the vessels and any modifications | Certified drawings (GA) of the vessels and any modifications |
| Prohibit underwater discharge from buffer tanks/RSW tanks | Prohibit underwater discharge from buffer tanks/RSW tanks | Prohibit underwater discharge from buffer tanks/RSW tanks | Prohibit underwater discharge from buffer tanks/RSW tanks |
| | | Ban on installations allowing the diversion of fish from the grading machine to the sea | Ban on installations allowing the diversion of fish from the grading machine to the sea |
| | | No mincing equipment | No mincing equipment |
| Monitoring measures | | | |
| | Define the stage in the fishing operation beyond which the fish will not survive (“ <i>point of no return</i> ”) | | Define the stage in the fishing operation beyond which the fish will not survive (“ <i>point of no return</i> ”) |
| | | Weighing/measuring on board before sorting/grading | Weighing/measuring on board before sorting/grading |

| | | | |
|---------------------------|---------------------------|---------------------------|---------------------------|
| CCTV connected to sensors | CCTV connected to sensors | CCTV connected to sensors | CCTV connected to sensors |
| Flowmeter | Flowmeter | Flowmeter | Flowmeter |
| Effort control | Effort control | Effort control | Effort control |
| Observers | Observers | Observers | Observers |

References

Alverson, Dayton L., Freeberg, Mark H., Murawski, Steven A., Pope, J.G. *A global assessment of fisheries bycatch and discards*. Food and Agricultural Organization (FAO). 1994.

A Maximized Retention and Monitoring Program For the Pacific Whiting Shoreside Fishery. Draft Environmental Assessment by the Pacific Fishery Management Council. 2007.

Archipelago Marine Research Limited. *BC Area A Crab Fishery*.

<http://www.archipelago.ca/highlight.aspx?ID=CF3EA83A-DB53-4F69-B787-3F7AEF432C2B>.

Date Retrieved August 3, 2009

Area 'A' Crab Fishery Fee Schedule. 2009.

Clucas, Ivor. *A Study of the Options for Utilization of Bycatch and Discards from Marine Capture Fisheries*. FAO Fisheries Circular No. 928 FIIU/C928. October 1997.

Discard Ban and the reform of the Common Fisheries Policy. Oceana. April, 2009.

Environmental-friendly fishing methods. Fisheries.No. February 20, 2009.

http://www.fisheries.no/Environmental_impacts_aspects_Norwegian_fisheries_aquaculture/environmental_aspects_resource_management/fishing_methods.htm. Date Retrieved June 26, 2009.

G Pilling, J Nichols, A H Hoel, A Hough, S Davies. *Norwegian North Sea and Skagerrak Herring Fisheries*. Moody Marine Limited. 2008.

Graham, et al. *Fishing Practice, gear design, and the ecosystem approach-three case studies demonstrating the effect of management strategy on gear selectivity and discards*. July 30, 2006.

Information on Fisheries Management in the Kingdom of Norway. January 2005.

<http://www.fao.org/fi/oldsite/FCP/en/NOR/body.htm>. Retrieved June 11, 2009.

Isaksen, B., Valdemarsen, J.W., Larsen, R.B. & Karlsen, L. 1992. *Reduction of fish bycatch in shrimp trawl using a rigid separator grid in the aft belly*. Fish. Res., 13: 335 - 352.

MSC Sustainable Fisheries Certification Program. *Final report for the Scottish Pelagic Sustainability Group Ltd North Sea Herring*. Food Certification International. 2008

Norway Trade Policy Review. World Trade Organization.

www.wto.org/english/tratop_e/tpr_e/s205-04_e.doc. Date Retrieved June 6, 2009

Pilling, Nichols, Hoel, Hough, and Davies. *Norwegian North Sea and Skagerrak Herring Fisheries*.

Saelens, M., Jesse, L. *Shoreside Hake Observervation Program 2006*. Marine Resources Program, Oregon Department of Fish and Wildlife.

Scottish Pelagic Sustainability Group Ltd. <http://www.scottishpelagicsg.org>

Soldal, Breen. "*Survival*" *Surviving the trawl*. 2003.
www.profetpolicy.info/files/SURVIVAL.pdf. Date Retrieved July 24, 2009

VoyageMaster II S-VDR, Northrop Grumman - Sperry Marine.
<http://www.es.northropgrumman.com/solutions/voyagemaster2svdr/assets/s-vdr.pdf>

Wiedoff, B., Conrad, J. & Parker, S. *Shoreside Hake Observation Program*. Marine Resources Program, Oregon Department of Fish and Wildlife. 2003.

Workshop on Discard Sampling Methodology and Raising Procedures, Final Report. Danish Institute for Fisheries Research. September 2003.