IS FISHERIES DIVERSIFICATION A SUSTAINABLE STRATEGY? THE CASE OF THE NEWFOUNDLAND REDFISH FISHERY

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Is fisheries diversification a sustainable strategy?

The case of the Newfoundland redfish fishery

by

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ABSTRACT

Canada's tenth province, Newfoundland and Labrador (NL), was built around marine resources. It began over 500 years ago, when Europeans came to discover new lands. Diversification into new species occurred over centuries due to changes in markets, technology, and resource abundance. The redfish (*Sebastes* species) fishery in NL has evolved and changed over time due to foreign participation, confederation with Canada, increased life history knowledge, and declining stocks. In 1992, when the cod moratorium occurred, there was a push to exploit other species, redfish being a primary contender.

In this paper, I examine the history of the northwest Atlantic redfish fishery from a diversification viewpoint. By analyzing the literature regarding all aspects of the redfish fishery, I examine the diversification potential of the species in the mid-1990s, and determine if redfish can help ease the burden of the fisheries crisis. I find that the mismanagement of the fishery and the biological characteristics of redfish combine to put the resource in a vulnerable state from which it has yet to recover. It is therefore unsuitable for increased exploitation. This conclusion is supported by an examination of the experience with diversification in the community of Gaultois.

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List of Abbreviations

DFO	Department of Fisheries and Oceans
EEZ	Exclusive Economic Zone
FRCC	Fisheries Resource Conservation Council
NAFO	Northwest Atlantic Fisheries Organization
NEAFC	Northeast Atlantic Fisheries Commission
TAC	Total Allowable Catch

1. Introduction

Since 1993, when the cod fishery collapsed, those involved in the fishing industry in Newfoundland and Labrador have struggled to find solutions to what is widely felt as a crisis. It was important to seek pragmatic responses to the catastrophe not just because participants in the fishing industry were faced with a significant loss of income, but also to determine ways in which the Province and the country could manage resources sustainably. Diversification into other species seemed like a viable solution. Pressure on other marine fish species, both shellfish and other groundfish, gave many hope that all was not lost. This paper explores the shift from Atlantic cod to redfish (*Sebastes* sp.) and considers whether increasing exploitation on redfish is a realistic solution to problems facing the Newfoundland fishing industry.

Diversifying the fishery is an essential step in attempting sustainable exploitation of alternate species. Diversification decreases, and sometimes eliminates pressure on stocks that are struggling to survive or recover. However, redirecting activity from one species to another is not an easy task. Although the same gear and processing equipment may be used for two separate species, much more needs to be considered. Life history (or life cycle) characteristics are the primary factors that seriously affect a species' ability to recover. In addition, after the cod moratorium management regimes needed to shift their focus from harvesting to recovery management, and look for a species that could replace cod as a source of income in the fishery. Regulations and guidelines for a species that is in severe decline or already collapsed are quite different from one that is in stable condition. For stocks in a secure state, the goal centers on profitability and socio-economic contributions. In these cases, conservation is a consideration as a means of

ensuring the continued viability of the fishery. The situation is quite different when a fishery is at risk of being shut down. Early efforts should attempt to pre-empt closures, for example by reducing fishing effort. Politics often interfere with conservation goals as the focus is centered on participants in the fishery instead of on the risks to species. In the case of groundfish (redfish and cod in the northwest Atlantic), efforts should have been balanced between stock recovery and sustainable diversification into other species. All too often there is a reactive mode of management, attempting to solve problems that could perhaps have been avoided with proactive regulatory measures.

The fishing industry is an important element in the culture, settlement, and economy of Newfoundland and Labrador. For the island of Newfoundland especially, the fishery was the raison d'être. It has been one of the most significant employers for the Province, and also it has influenced the formation of cultural, social, and political institutions (Hanrahan 1993). Discoveries of new stocks throughout the northwest Atlantic, and technological advances in gear and harvesting and processing equipment have all contributed to a more efficient fishing industry. Initially these improvements made the fisheries more profitable as harvesters were able to go further from shore, fish in inclement weather, and catch more fish in less time. However, these innovations also compromised the conservation and sustainability of the species as well as changed the industry and its participants from a fishery composed primarily of inshore, small-scale harvesters to one comprising a significant element of offshore companies with weaker local ties.

The cod collapse forced the participants in the Newfoundland fishing industry to consider diversification into other species, but these species were not immune to

overfishing and severe stock declines. The cod moratorium not only made diversification necessary, but it also raised awareness of the need for a biologically sustainable and economically viable management regime. The Newfoundland groundfish fisheries have required some type of transformation in the last two decades. Although diversification is not a panacea, it can offer a solution to some challenges and allow fishery participants to remain in perhaps the only occupation they know. However, diversification can not be successful unless practices are in place that underline the importance of conservation for prolonged exploitation. Simply switching from one species to another is not enough to alleviate harvesting pressure and magically restore stocks. Indeed, the shift needs to be coupled with an approach in which the industry adapts to new goals of recovery of collapsed species, and respects sustainability guidelines for other species that may be subject to more intense exploitation. It is essential to learn from past mistakes, change protocols that do not work, and make management strategies specific to each species.

To better understand if redfish can offer a sustainable diversification option for the Newfoundland fishing industry, it must be clear what is meant by sustainability in this paper. A widely accepted definition of sustainable development comes from the World Commission on Environment and Development. According to a report issued by this organization, sustainable development "meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland 1987). For fisheries sustainability in Newfoundland and Labrador, a more detailed definition is necessary. Although sustainability, at its core, concerns a resource's longevity, the sustainability involves human beings manipulation and exploitation of the resource for their prolonged benefit. When discussing fisheries resources, participants are

most concerned with the economic benefits they can gain from harvesting a species. Fisheries management involves developing natural resources so that the resource remains abundant far into the future while continuing to provide consistent and significant economic benefits. Commercial and ecological sustainability are both paramount to a successful fishing industry (DFO 1993). It is essential to manage fisheries because it is known that they can be depleted and be driven to extinction (see e.g. Charles 1994). For the purpose of this research, sustainability involves the integrity of the natural environment and the abundance of the resource, the economic benefits gained from the resource, and the longevity of communities utilizing the resource. In addition, relating the resource sustainability to the longevity of the communities throughout the Province gives a new perspective and importance to properly managed fisheries resources in this region. It is not only about money and economic return, but also a way of life.

Examining the northwest Atlantic redfish fishery presents new challenges to diversification as a strategy to deal with the socio-economic consequences of closures. Life history characteristics that are drastically different from those of other commercially exploited groundfish species, past stock declines, closures, and mismanagement, all call into question the potential of redfish to alleviate the fisheries crisis. It appears that redfish is therefore a questionable candidate for diversification.

This paper attempts to address the specific question of whether fisheries diversification is a sustainable option for collapsed species. Sustainability, for the purpose of this research, involves both prolonged economic and biological successes. The focus is on the northwest Atlantic redfish fishery. The research examines the life history characteristics of the species, the region's need for diversification, and the past

and present management strategies for redfish. All of these issues will be regarded in terms of how they might affect the species' potential to become a significant contributor to the economy, and the Newfoundland fishing industry in particular. The Newfoundland redfish fishery has not previously been examined in detail to determine its potential as a feasible and competitive alternative to the cod fishery in the Province. Yet, it has been identified as an underutilized species, and redfish landings have increased over the years, especially since the cod moratorium in 1992. However, these passive efforts have not been enough. It is now time to explore this option in an attempt to ascertain whether this species can in fact help diversify the fishery in Newfoundland and Labrador.

1.1. Research Problem

The central claim of this paper is that the Canadian Atlantic redfish fishery was mismanaged from the start. It is therefore ill-suited as a target for diversification. The redfish fishery was targeted as a candidate for diversification and labeled as an underutilized species in a region that continues to rely heavily on fisheries income and employment after the collapse of the cod fishery. Since the purpose of this paper is to determine the Newfoundland redfish fishery's suitability for diversification and potential to help ease the burden of declining fish stocks, two main questions must be addressed. First, how has the redfish fishery been managed in the past? Second, how have past management schemes affected its present potential for diversification?

The idea of diversification is to mitigate pressure on a variety of resources, leading to a balance in the industry that promotes sustainable, prolonged exploitation based on socio-economic or political factors, while taking into account ecosystem

integrity and biological diversity. This type of research can be expanded to address worldwide fisheries problems and could aid in determining solutions to crises that affect people all over the world. Communities worldwide rely on fisheries resources and many of these are in decline or on the verge of collapse. The demise and disappearance of the stocks have important consequences biologically, economically, and socially. Developing remedies to offset past mistakes can significantly affect people who rely on fisheries for their main source of income.

1.2. Methodology

In order to examine this problem, I will analyze the development of the redfish fishery for Newfoundland. All aspects of the fishery will be examined, including harvesting and processing techniques, increased biological knowledge of the species, market and product expansion, stock status and abundance, and increased exploitation effort in the wake of the cod collapse. All of these areas will be related to the policies and regulations for the fishery and the social and economic role of the fishery. Attention will be on the management history, the repercussions of the relevant management practices, and its effects on the diversification potential of the species. To this end, an extensive literature review will be undertaken. In addition, informal conversations[1], rather than formal structured interviews, with individuals knowledgeable about a small, remote, outport community in Newfoundland that relies heavily on the redfish fishery were conducted to

[1] Informal conservations were conducted via telephone and on the author's personal visit to the town of Gaultois, Newfoundland. When information learned from these conservations is used in this report, a footnote explains the title of the person providing the information.

learn from attempts at species diversification involving redfish. These conversations were carried out with the full knowledge and consent of the persons contacted.

2. Previous Literature

There are a variety of documents that address the issues raised in this Report, although none has considered the specific research questions examined here. This section discusses the most important sources upon which my research draws. In terms of management, the Fisheries Resource Conservation Council (FRCC) published a comprehensive overview of a number of groundfish stocks in Canadian waters (2003). In this document, the FRCC updates the status of different groundfish stocks, including five redfish stocks (Units 1-3, 3O, and Division 2+3K). This document is the main source for the total allowable catch (TAC) levels and landed amounts for the redfish stocks discussed in this paper. For each stock, the current status is listed, and the FRCC makes recommendations regarding exploitation levels and identifies further research needs regarding conservation. Because of the problems associated with the stock structure and dynamics in the redfish fishery, the FRCC recommends that future research focus on improving our understanding of the stock composition. This is considered essential to the sustainable and successful management of redfish stocks. The Redfish Multidisciplinary Research Zonal Program final report (Gascon 2003) combines papers and abstracts on a variety of topics concerning the redfish fishery, including stock structure, management approaches, and recruitment studies. The research was undertaken between 1995-1998 with the primary goal to better understand the species in order to ensure long term sustainability and economic viability of the fishery. The FRCC document refers to this research and it

recommends follow-up work in certain areas (i.e. seal predation on redfish) in order to better determine the level of impact on the state of the redfish fishery.

Rose (2007) provides general historical information on groundfish fisheries in the northwest Atlantic, specifically the cod fishery, from its inception in the 16th century to its collapse in 1992, and beyond. Rose's analysis helps explain the need for diversification based on the state of groundfish fisheries. It also helps support the claim made in the present paper of mismanagement of the Newfoundland fishing industry. One important attribute of redfish management that is different from other groundfish fisheries is that they are managed as stocks rather than by species. Distinguishing amongst the different *Sebastes* species that comprise the northwest Atlantic stocks and their growth rates are major concerns for proper management of the fishery (Misra and Ni 1983; Ni and Sandeman 1984; Ni 1981 and 1984).

The biological characteristics of redfish have contributed to making diversification difficult in Newfoundland. The reasons are outlined in Morin et al. (2004), who detail the life history, including growth rates, age at maturation, fecundity, and their distribution. The authors relate these characteristics to management and conservation strategies. The main issues revolve around the species' slow-growing, long-lived, and late-maturing life history, distinguishing them from other commercially exploited groundfish in the northwest Atlantic, and changing their recovery potential and effective management strategies.

This paper will argue that the redfish fishery has long been mismanaged and that this, along with the species' unique life history characteristics, makes diversification difficult. In order to make a proper assessment of the diversification potential of redfish

for the Newfoundland region, it is necessary to analyze first the recovery potential of the species. Hilborn et al. (2005) outline the methods used in successful management systems, while others examine causes of fisheries collapses and recovery schemes (Roughgarden and Smith 1996; Jackson et al. 2001; Hutchings and Reynolds 2004). Stefansson and Rosenberg (2005) address management of fisheries under uncertainty - an issue central to the redfish fishery. In addition, it is necessary for managers and scientists to consider the difficulties in making predictions about stock development for purposes of fisheries management, and to place greater emphasis on assessing the status of the resource prior to developing harvesting strategies and setting quotas (Caddy and Seijo 2005). The precautionary approach is considered in this paper as an effective management strategy for the redfish fisheries in Newfoundland. This principle involves a balance between acquiring information and decision making. The key is in keeping policy making active while information is being gathered. Given the well-known data inadequacies, it stands to reason that it is advisable to err on the side of caution. Documents by Atkinson (2000) and Caddy and Seijo (2005) are examined for further information on this topic.

These sources, along with others (Parsons et al. 1976; DFO 2005; Pauly et al. 2005), offer a wealth of information not only on the northwest Atlantic redfish fishery, but also on other groundfish fisheries in the same region. They make evident numerous issues hindering not only the potential for redfish in easing the fisheries crisis, but also the difficulty in managing the fishery successfully and sustainably in a more general sense. As will be seen below, details on management techniques and socio-economic impacts

derived from the literature, from both a local and global perspective, are applicable and relevant to the Newfoundland redfish fishery.

3. The Record of Management

The northwest Atlantic redfish fishery began in the Gulf of Maine in the 1930s (White 1954; Kelly et al. 1972). The fishery expanded significantly between 1948 and 1952 with the discovery of new stocks throughout the northwest Atlantic and, notably, in the waters around Newfoundland. But the first noteworthy amounts of redfish were not landed until 1953 (Sandeman 1973). Atlantic Canadian provinces and Quebec have all participated in the redfish fishery since its inception, but the provinces of Newfoundland and Labrador, and Nova Scotia have historically been the major participants. This is primarily due to proximity to the resource in these provinces. The primary redfish stocks harvested and processed in Newfoundland and Labrador since the beginning of the fishery include Unit 1 [Gulf of St. Lawrence], Unit 2 [Laurentian Channel], Unit 3 [Scotian Shelf], 3O [Grand Bank], Division 2+3K [Hamilton Bank], and 3M [Flemish Cap] (Figure 1). However, Unit 1 was closed as a directed fishery in 1995, and Division 2+3K was closed in 1997.

The redfish fishery in Newfoundland evolved rather slowly and was primarily driven in the early stages by replacement of collapsed stocks, rather than by demand and new markets. Redfish were originally caught as bycatch and discarded due to lack of market for the species. The commercialization and increased exploitation of the fishery resulted from an increase in demand for frozen fish in the United States (Kelly et al. 1972; Dawe 1976). Yellow perch from the Great Lakes region of North America, the staple of the frozen food industry, was in decline and redfish were found to be

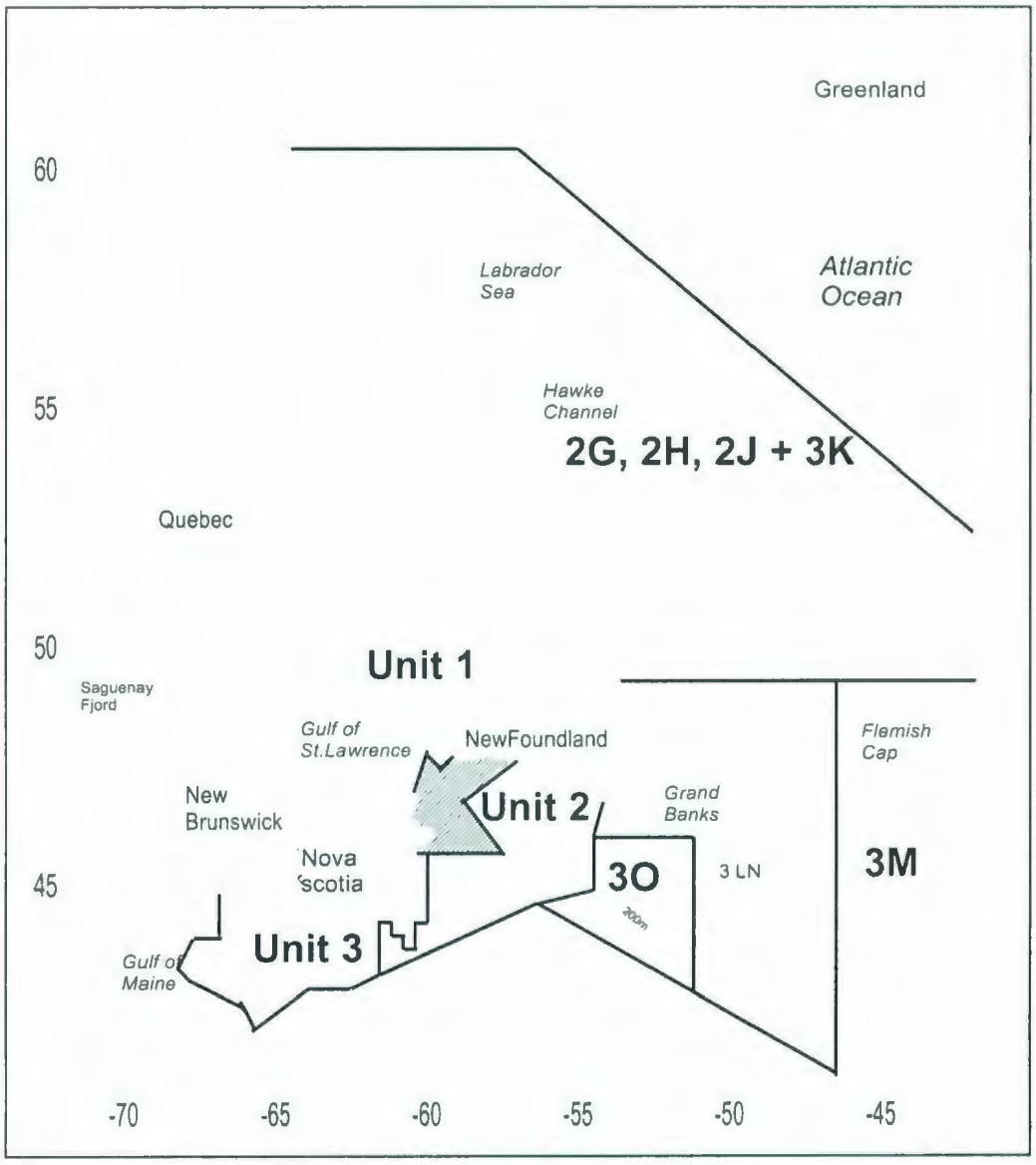

Figure 1. Map of six redfish management units in the Northwest Atlantic: Unit 1; Unit 2; Unit 3; 3O; 3M; and Division 2+3K.
Source: NAFO. Note that map has been modified from its original version.

comparable to yellow perch in freezing ability. The increase in demand, the decline in yellow perch, and the advancements occurring in packaging, freezing, and transportation technologies, all helped expand the redfish fishery with a minimal amount of promotional effort by the fishing industry (White 1954). Frozen fish sticks emerged in the 1950s, and by 1956 Newfoundland had captured about 50 percent of the frozen fish market for fish sticks. In addition, lower quality and lower priced fish can supply this market (Rose 2007), and redfish falls into both categories.

Often sold under the name ocean perch (Kelly et al. 1972), markets developed gradually for redfish, although demand in Atlantic Canada was minimal primarily on account of the perception of the species as a 'poor man's meal' (Dawe 1976). This made it difficult to promote harvesting and consumption of the species locally. Presently, the primary redfish markets for Canada are in the United States, Europe, and Asia. For the US and European markets redfish is fresh packed and filleted[2] (Kelly et al. 1972); the Asian markets prefer the product to be whole round, with little processing[3] (O'Leary et al. 1985). The fishery reached a peak in 1959, with Canadian landings amounting to almost 400,000 metric tonnes (McKone and LeGrow 1990; Lear 1998). Catches decreased significantly after this period, hovering between 100 – 200,000 metric tonnes for most of the 1960s and 1970s (Lear 1998). Landed amounts began to increase in the 1970s, and reached a high for this period of about 160,000 metric tonnes for Canada in 1973 (Figure 2). Although the landings did not exceed 100,000 metric tonnes after 1975, redfish

[2] Eric Day, Union representative for the Harbour Breton Fish Plant. Personal communication. 20 February 2007.
[3] Murray Engram, Mayor of Gaultois. Personal communication. 11 April 2007.

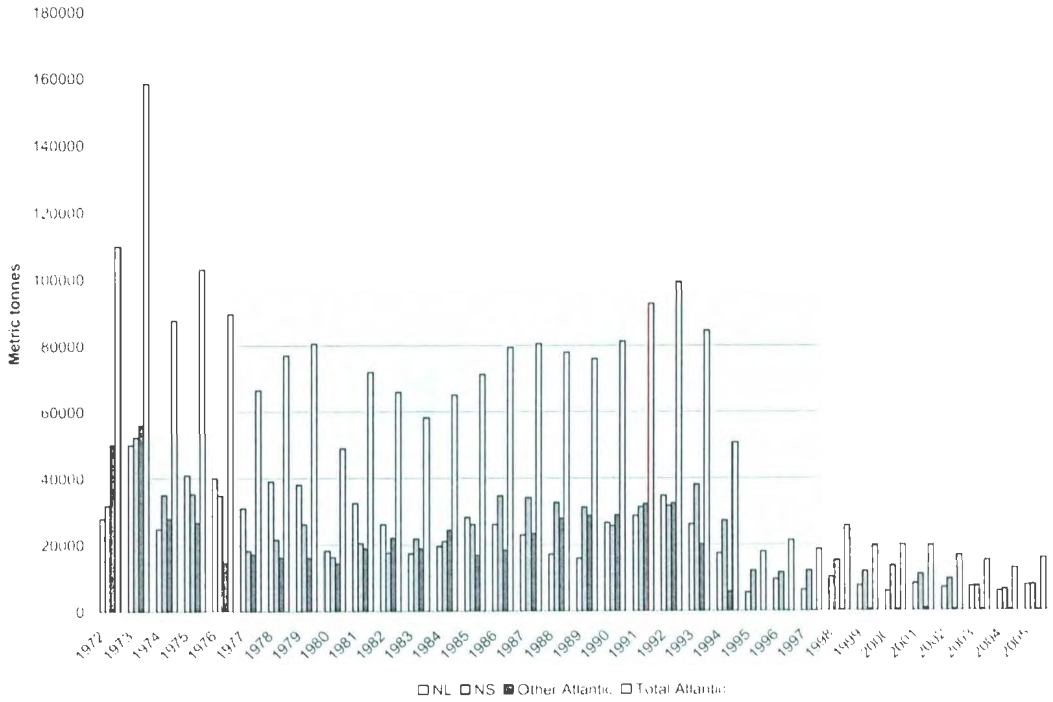

Figure 2. Canadian redfish landings for 1972 to 2005. Amounts shown for Newfoundland and Labrador (NL), Nova Scotia (NS), and other provinces (New Brunswick, Prince Edward Island, and Quebec).
Source: DFO.

provided an important contribution to the Newfoundland fishing industry and to the livelihoods of its participants.

When the cod moratorium was announced in 1992, effort and fishing pressure in the redfish fishery increased. Redfish landings soon comprised almost 50 percent of the total Newfoundland groundfish landings (Figure 3). This is notable since the groundfish fishery includes over thirteen species. In economic terms, redfish accounted for almost 30 percent of total groundfish value in 1994 (Figure 4). So, the stage was set for diversification, and redfish appeared as a possible contender.

3.1. Biology

The biology, life history traits, and past management practices have greatly affected the recovery potential of the species. As noted previously, redfish are a slow-growing, long-lived, and late-maturing deepwater fish with an extremely low instantaneous natural mortality rate (Mayo et al. 1979; NEFMC 1993). They reach an average age of approximately 40 years (McKone and LeGrow 1990), but specimens more than 75 years old have been found (Morin et al. 2004). Redfish typically occur at depths ranging from 130 meters to 750 meters, but have been caught in water as deep as 1100 meters (Scott and Scott 1988). These factors influence regulations in place for standard monitoring and exploitation of the resource as well as impact recovery plans. If rates of recovery of marine fish species are indeed related to life history and habitat preferences, then this information should be helpful in devising redfish recovery strategies. For instance, evidence suggests that pelagic species recover faster than demersal species and that recovery is more prevalent and faster in early-maturing species versus late-maturing

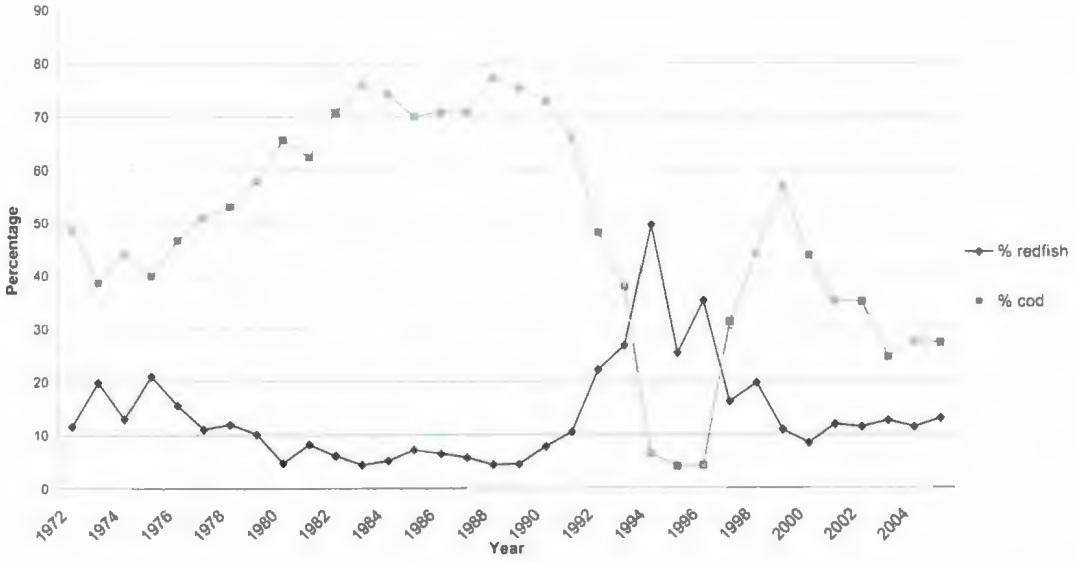

Figure 3. Cod and redfish percentages of total groundfish landings in Newfoundland from 1972 to 2005.

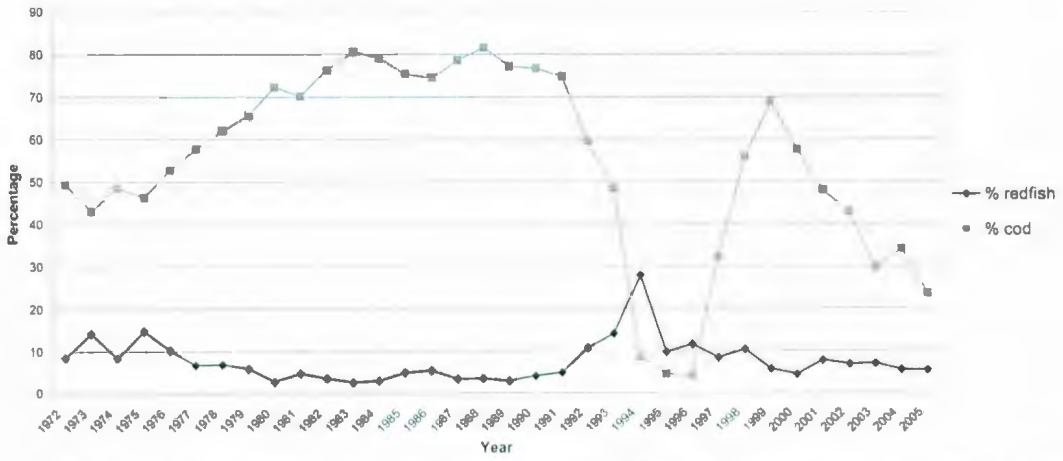

Figure 4. Cod and redfish percentages of total groundfish values in Newfoundland from 1972 to 2005.

species (Hutchings and Reynolds 2004). This would suggest that redfish have more obstacles to overcome than many other commercially important groundfish species in the northwest Atlantic. It is important that policies regarding general exploitation or stock renewal take these points into consideration.

Deep-water habitat preferences of redfish lead to difficulty in obtaining biological information, and in monitoring changes in environmental conditions over time. These factors decrease the chances for a resource to be managed sustainably because there is more uncertainty regarding stock dynamics (Hilborn et al. 2005). Abundance indices, growth rates, age at sexual maturity, life span, and natural mortality rates all contribute to management decisions and aid scientists and managers in determining how a species may respond to exploitation, and how recovery of the stock might best be achieved. In addition, because they are a deep-water species, redfish suffer 100 percent mortality when brought to the surface quickly by fishing gear (Fisheries Diversification Program 2001). This makes the bycatch issue more problematic than in some other fisheries where the bycatch mortality is lower. To address this problem, experiments were conducted to determine methods which would decrease the bycatch of immature redfish while maintaining a large and economically viable catch (Hickey et al. 1995; Fisheries Diversification Program 2001).

Another problem of redfish management is the difficulty in distinguishing amongst the different species that comprise the northwest Atlantic redfish stocks. Because of their different population dynamics, properly defining the various stocks is key to successful management. The redfish harvested by Canada in the northwest Atlantic consists of three different *Sebastes* species (Scott and Scott 1988): *Sebastes*

marinus (Linnaeus 1758), *Sebastes fasciatus* (Storer 1854), and *Sebastes mentella* (Travin 1951). Because of the relative difficulty of distinguishing amongst the three species (Ni 1981), redfish are managed by stocks instead of by species in the northwest Atlantic (DFO 1997). However, one species may dominate a certain stock (Scott and Scott 1988). Furthermore, genetics research undertaken under the auspices of the Redfish Multidisciplinary Research Zonal Program (Gascon 2003) concluded that biological stock units of redfish did not correspond to the management units as currently defined, meaning that the populations may occupy much larger areas than their corresponding management units. By contrast, the Atlantic cod stocks in the northwest Atlantic are comprised solely of *Gadus morhua*. Although temperature differences may occur in different regions, the basic temperature, habitat, and feeding preferences are the same amongst all cod stocks because they are comprised of only one species. Managing up to three different species as one can have dramatic and unpredictable outcomes if proper measures are not taken. Slight differences in the life history of the three different species can drastically affect recruitment or recovery of the stocks. In the case of the Unit 1 stock, the current classification was not implemented until 1993. Previously, the Gulf of St. Lawrence redfish stock was managed as Divisions 4RST (FRCC 2003). The stock was redefined in 1993 to take into consideration the winter migration into the Cabot Strait region. Unit 1 redfish is managed as one stock but is comprised of both *S. mentella* and *S. fasciatus* and there is still uncertainty about the level of mixing between the Unit 1 redfish and Unit 2 (Laurentian Channel) redfish stocks. Furthermore, a hybrid of the two species has also been found in both of these units (DFO 2004). The FRCC suggested that Units 1 and 2 be considered a single stock, deeming a re-examination of the current delineation of the

stock necessary to ensure the species was being managed successfully regardless of seasonal migrations (2003). Like in the Unit 1 region, there is a need to better understand the stock dynamics of the redfish in Division 2+3K (FRCC 2003; Thomson 2003). Suggestions have been made to investigate this issue as well as keeping the fishery closed to direct fishing and to only allow a limited bycatch fishery (FRCC 2003).

Determining age structure and growth rates is essential to proper management of the species, but it has been proven difficult to do so in practice. Incorrect estimates of redfish age, growth, and mortality can cause overexploitation based on an erroneous understanding of stock structure and growth (Saborido-Rey 2004). This problem is compounded by the fact that management units contain a variety of species. In addition, because redfish are such a long-lived species, the size and age distributions can be very dispersed. Smaller mesh size in the codend of a trawler helps minimize the capture of redfish that are smaller than the minimum harvestable size (22cm). However, fish of this size may still be too small to market. Careful attention must therefore be paid to prevailing economic conditions when harvesting regulations are set. Moreover, in order to ensure sustainable harvesting, it is necessary to consider the age distribution as well as the size distribution. Specifically, the minimum harvestable size must be set so as to ensure that the specimens harvested have reached sexual maturity. Removing individuals that have not yet reproduced can severely compromise the longevity of the resource.

3.2. Stock Status

The shift to different groundfish species after the cod moratorium presented the industry with an opportunity to learn from past mistakes. With one major resource under

moratorium, lessons from the past could have paved the way for unique, innovative protocols for different or similar species. However, because the cod closures happened so suddenly, there was political pressure to increase exploitation of other species like redfish too quickly. In hindsight, it appears there was not enough reflection on differences amongst species.

In earlier times, there was little active management of the cod fishery for Newfoundland harvesters, both before and after confederation with Canada. This was because the fishery was primarily an inshore fishery with both food and commercial components, and the methods of extraction were relatively modest in terms of productivity per unit effort. There was always competition amongst harvesters, but this increased with advances in technology and evolving jurisdiction regarding fishing grounds amongst various nations. With the establishment of the 200-mile limit in November 1976, Canada had a better idea of its entitlements and it provided a measure of control as to how best to manage these valuable resources. Managing fisheries involved managing national harvesters, as well as allowing enforcement inside and outside national waters to ensure regulations were being followed by everyone. Management challenges were accompanied by obstacles associated with establishing policies appropriate for five different Canadian provinces as well as dealings with other countries, some as far away as Asia. For Newfoundland, these policies needed to maintain the island's integral partnership with the ocean.

The evolution of the management and policies regarding the groundfish fisheries in the northwest Atlantic emerged according to the priorities of that particular time. Those priorities in fisheries policies in Atlantic Canadian waters have changed over the

last three decades. With the institution of the 200 mile limit, Canada's fisheries policies focused on establishing control over fisheries resources within this zone and establishing suitable management and enforcement practices. The 1980s saw efforts directed towards expansion and advancements in the harvesting and processing sectors. In addition, priority was given to develop a system for regulation of the different fleet sectors. In the 1990s, the focus shifted to conservation in the wake of stock declines and collapses. This involved reducing capacity as well as concerted attempts to develop and utilize more responsible fishing practices (DFO 2001).

When it came to policies and regulations for redfish, they remained the same as those pertaining to most other groundfish species like cod, despite the differences in life history and the declines of stocks in the past. Surveys were conducted and biomass amounts estimated to determine the TAC for each stock. TAC's are a measure attempting to ensure that exploitation can occur over a prolonged period of time. However, they are not a sure-fire tool to sustainability. Instituting TAC levels based solely on scientific surveys or past history is now widely understood to be inappropriate. Life history characteristics need to be analyzed to decide what is proper for each species. The point is that since the life history characteristics of redfish are distinct from other commercially exploited groundfish species in the northwest Atlantic, regulations need to reflect these differences.

Currently, the popular attitude to management and policy is the precautionary approach. The precautionary approach involves consideration of uncertainties and emphasizes that lack of information should not be followed by lack of action. It involves clearer definitions of roles of scientists and managers and considers socio-economic

conditions as well as biological ones (Atkinson 2000). This method seems like a responsible way to manage fisheries, and seems appropriate for a fishery such as that for redfish since this fishery is perhaps particularly plagued by uncertainties with regard to stock composition and recruitment. There is an element of uncertainty in the development of any fishery. That is, from year to year, there is no way to be sure how much resource will be harvested, how much is available to be harvested, and how present harvesting will affect future harvesting (Charles 1994). Scientists and managers do the best they can, making educated estimates based on surveys, biological data, and historical experiences. Because all uncertainties can not be eliminated, it is necessary to take an adaptive approach. The precautionary approach is adaptive in that it is flexible and forward-looking. However, it is not yet firmly entrenched as it reflects relatively recent thinking about how best to replace decades of ad hoc solutions often influenced more by politics than scientific evidence.

Unit 1

A review of the current status of redfish stocks reveals weaknesses in the management schemes for this fishery. The Gulf of St. Lawrence Unit 1 redfish stock had supported a large fishery for Canada from 1970 to 1976 (see Figure 1). This stock was heavily exploited and supplied most of Canada's redfish in the 1970s (Sandeman 1973). By 1977, the redfish biomass in Unit 1 was believed to be only one fifth of what it was in 1970. Attention was then drawn to the need for conservation of this stock. Another peak in Unit 1 biomass was experienced in the early 1990s, but there was an immediate steady decrease directly following this peak (FRCC 2003). Pressure from both a targeted fishery

as well as bycatch caused the collapse of this stock (Fisheries and Environment Canada 1977) and necessitated a moratorium instituted in 1995.

There are a variety of theories about the causes of the Unit 1 demise. However, it would appear that declines in the adult population were most likely caused by overfishing, as these declines ceased when the fishery was closed (Morin et al. 2004). However, there was also a decline in the small, immature redfish in Unit 1. This may have been caused by immature redfish bycatch in the shrimp fishery (Morin et al. 2004), predation, or natural mortality caused by environmental conditions (Gascon 2003). Nevertheless, the stock's collapse cannot be solely attributed to overfishing and poor recruitment. It is likely that mismanagement contributed significantly to the decline. Figure 5 shows discrepancies between TAC levels and landed volumes. From 1985 to 1989, catch totals fell within TAC levels. However, from 1990 to 1992, a period described as one of peak biomass and increased landings for this fishery, the landed amounts exceeded the TAC levels. In the two remaining years before the Unit 1 redfish fishery was closed in 1995, TAC levels and catch levels dropped rapidly.

What then caused the acute decline that led to the closure of the Unit 1 redfish stock? A catastrophic combination of overfishing, poor recruitment, and mismanagement is most likely to blame. Regarding a groundfish species like redfish, management must be conservative and steady because of the difficult and slow recovery process associated with the slow-growing, late-maturing, and long-lived nature of this species. A lack of enforcement also contributed to the mismanagement, whereby landings were allowed to exceed TAC's during a three-year period before the TAC was reduced sharply. However,

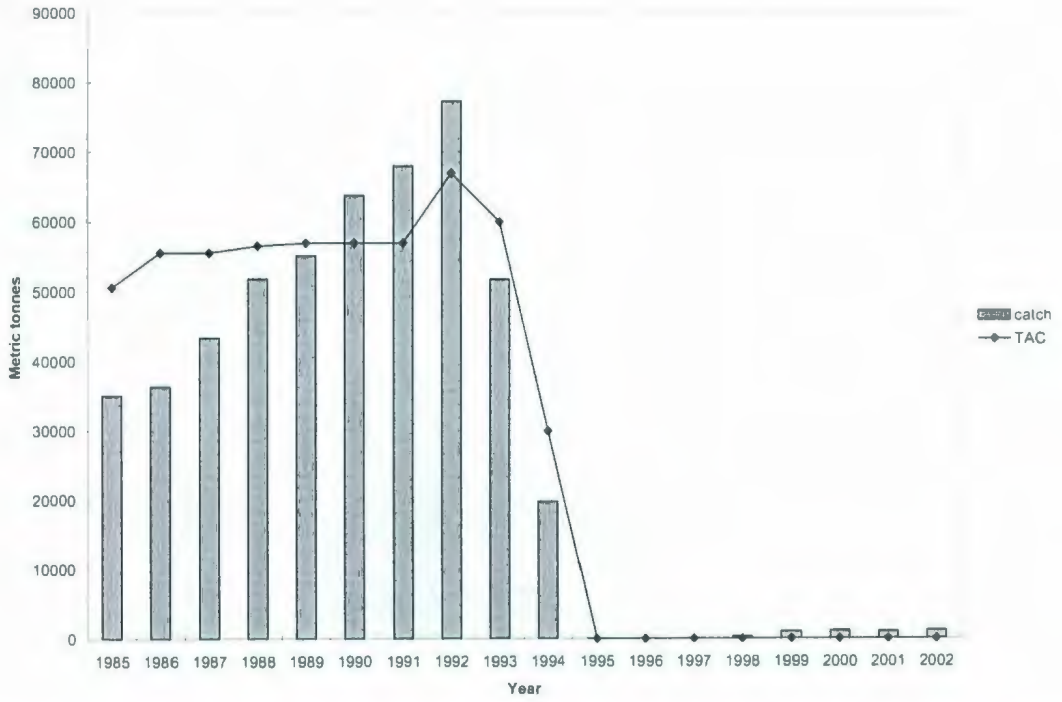

Figure 5. TAC levels and landed amounts of Unit 1 (Gulf of St. Lawrence) redfish from 1985 to 2002.

it appears that this corrective action was taken too late as the stock was subsequently closed to commercial fishing.

Division 2+3K

The Division 2+3K redfish stock did not experience persistent directed effort after 1990 (DFO 2005). In 1997 it was completely closed to directed commercial exploitation. Since 1997, the only fishing activities that have occurred in this area for redfish are survey trawls for the purpose of studying the stock and analyzing its status. In the case of this resource, the data shows that 1958-1960 landings were above a sustainable level. Landings in the period 1966-72 were below projected amounts given the level of effort. Like the Unit 1 stock, calls for conservation were made in the early 1970s (Parsons et al. 1976). In 1990, 2400 metric tonnes were landed by Canadian vessels. However, catches dropped to 280 metric tonnes in 1991 and remained lower than 19 metric tonnes from 1992 to 1997 (DFO 2005).

Unfortunately, the Division 2+3K redfish stock continues to be plagued by a poorly understood stock structure. The movements of the redfish in this area take them outside the 200 mile limit, making them vulnerable to harvesting by foreign vessels. This is believed to be one reason for the collapse and slow recovery of the resource. The pelagic redfish stock found primarily in the Irminger Sea between Greenland and Iceland is managed by the Northeast Atlantic Fisheries Commission (NEAFC). This is outside Canada's exclusive economic zone (EEZ), yet is believed to contain redfish from within Canada's jurisdiction, meaning that the stock is trans-boundary (DFO 2005). Canadian landings of redfish from this stock since the moratorium in 1997 are from bycatch in

Greenland halibut and shrimp fisheries, putting added pressure on the stock while in a state of recovery (DFO 2005). So, although a targeted fishery ceased in 1997, some amounts of redfish from this stock have been landed in Canada as bycatch in other fisheries.

Data from research surveys show that the resource was at a historically low level in 1994 (DFO 2005). Similar to the Unit 1 redfish stocks, the decline in abundance and consequent moratorium of the Division 2+3K stock occurred because of a multitude of factors. Even though there was no persistent directed harvesting of this stock after 1991, from 1987 to 1990 the TAC levels vastly exceeded landings (Figure 6). This is another example of improper management. Corrective action was taken, but it was too late to prevent full closure of the stock.

From 1990 onwards, the landings were indicative of a stock that should be surveyed and not commercially exploited. It is clear that the resource could not have survived any great effort. It is unclear why so many years passed before the fishery was closed. Ignorance of the precarious state of the stock is a possibility. Political pressure to continue to allow fishing is another.

Unit 2

Although other northwest Atlantic redfish stocks are not yet under moratoria, they are not exempt from inappropriately set TAC levels. Nor have they benefited from conservative action in the wake of poor recruitment. The consequences have simply been less severe or noticeable than for the other stocks. The Unit 2 (Laurentian Channel) redfish stock has experienced a significant decrease in TAC, going from 28,000 metric tonnes in 1993 to

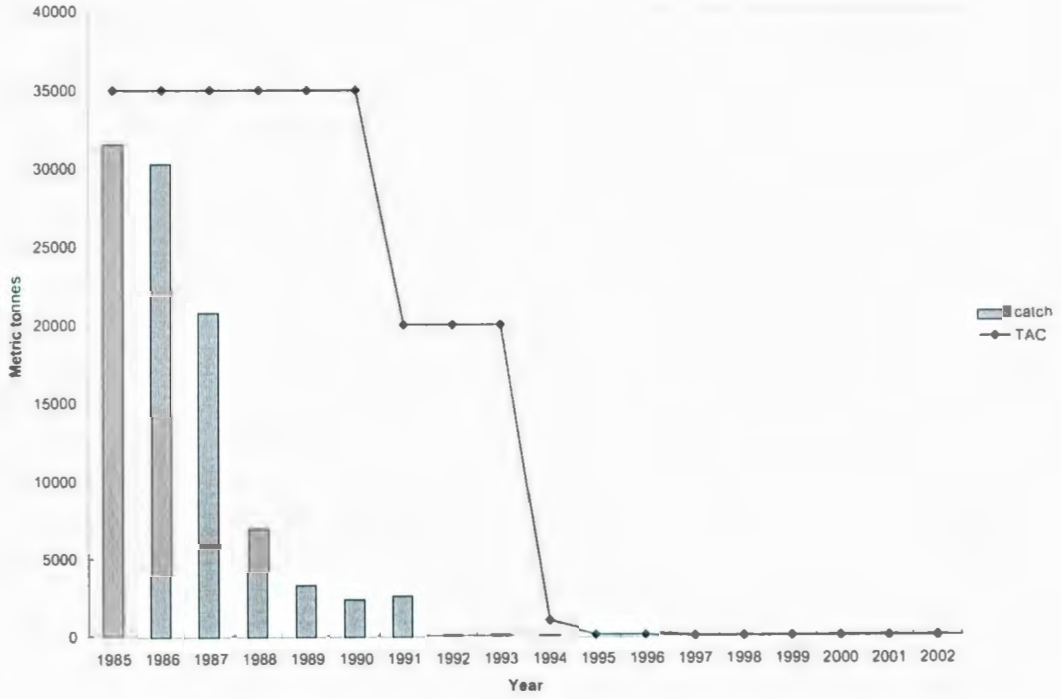

Figure 6. TAC levels and landed amounts for Division 2+3K (Hamilton Bank) redfish from 1985 to 2002.

only 8,000 metric tonnes in 2003 (Figure 7). The overall stock condition is considered stable and the current exploitation level is categorized as low (FRCC 2003).

3O and Unit 3

Redfish in 3O are in a situation similar to that in Unit 2 for landed amounts sometimes exceeding TAC levels (Figure 8). However, in the case of 3O redfish, the overall stock condition appears stable, yet the level of current exploitation is uncertain. 3O redfish are more heavily exploited than those in Unit 3, whose exploitation level is also unknown (FRCC 2003). However, in Unit 3, the landed amounts have never exceeded TAC levels (Figure 9), unlike the situation with each of the other stocks described. Unit 3 exemplifies a stock that has little demand for such a high TAC. This raises the issue of balancing TAC levels with demand and realistic expectations for catches. Although it may be acceptable to catch more redfish than what is currently being landed, it is essential to determine why there is such a discrepancy. If the effort has decreased due to lack of demand, then the problem is perhaps not serious. However, if the difference is due to steady or increased effort with less return, there may be a need to recalculate the TAC levels and determine if a decrease should be made to ensure sustainable exploitation.

4. Diversification

Diversification in the fishing industry can take a variety of forms. It may manifest itself in product differentiation or in product enhancements that add value to the end product. The sources of such changes are typically developments in the markets for the species in question or technological developments. A sector of the industry may find that markets

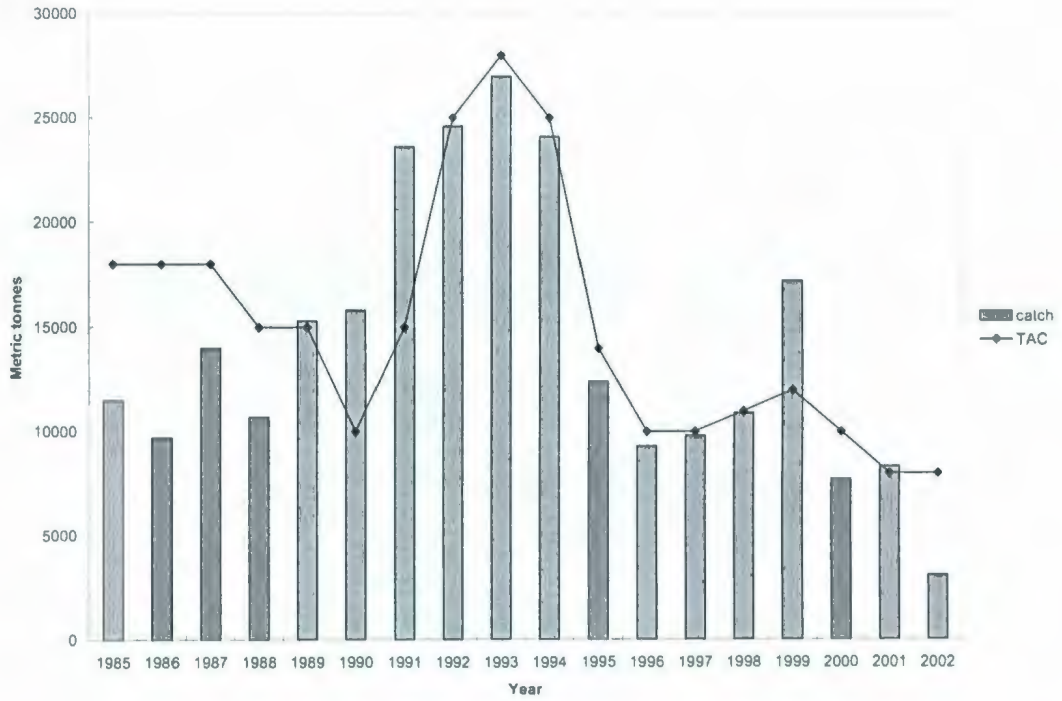

Figure 7. TAC levels and landed amounts for Unit 2 (Laurentian Channel) redfish from 1985 to 2002.

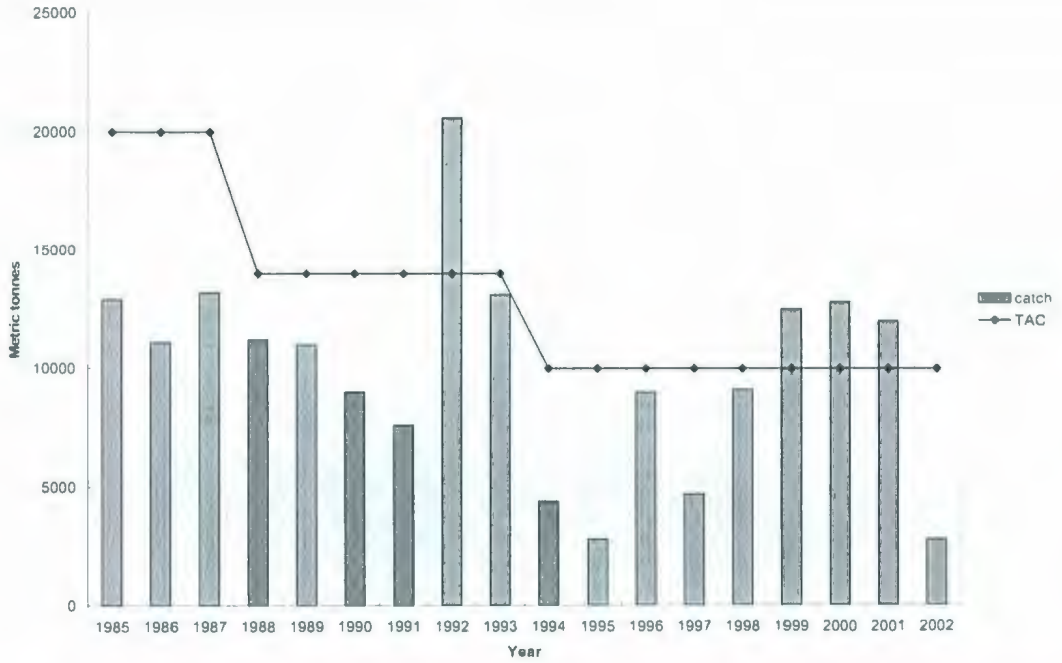

Figure 8. TAC levels and landed amounts for 3O (Grand Bank) redfish from 1985 to 2002.

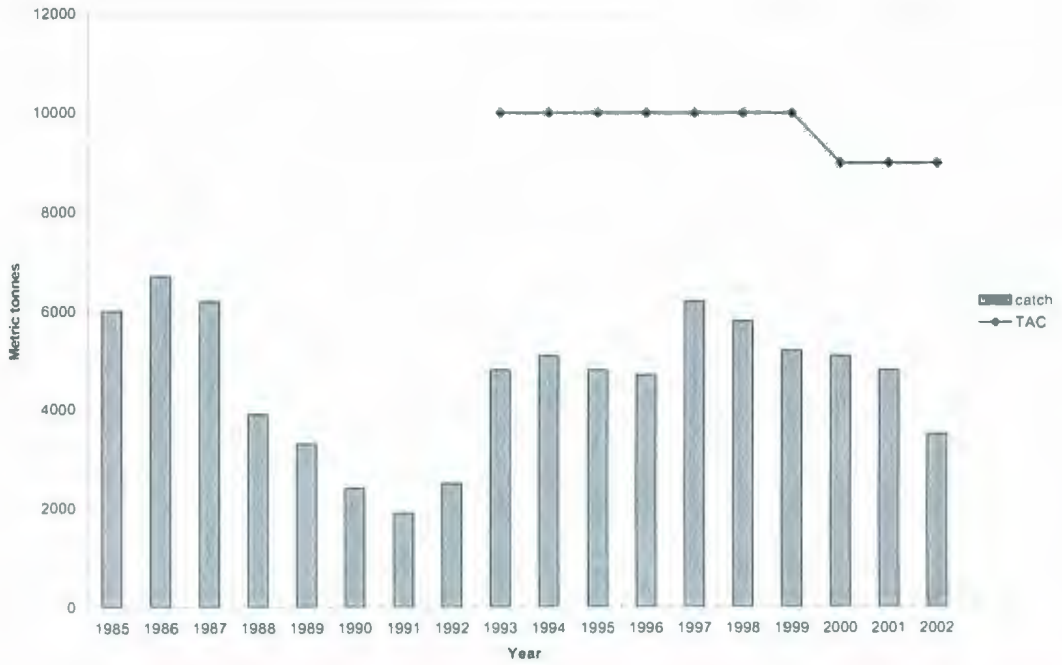

Figure 9. TAC levels and landed amounts for Unit 3 (Scotian Shelf) redfish from 1985 to 2002.

have grown for a particular species or product. Fishing may occur in new areas, or innovation in harvesting techniques may occur. Sometimes diversification is experienced through a shift to a species that has not previously been subject to commercial harvesting. For the purpose of this paper, diversification means increasing pressure on a species that is already being exploited, albeit at low or very low levels. According to the Atlantic Fisheries Adjustment Program (DFO 1990), redfish were an underutilized species in the early 1990s. In the wake of the cod collapse, diversification seemed like a practical solution. In theory, exploiting different species should help take the pressure off a declining stock. Indeed, successful diversification is possible. However, it may be argued that the manner in which it was executed in Newfoundland in the mid 1990s did not represent success. To see why, consider the historical background that led to redfish being targeted for diversification.

The cod fishery was the catalyst for settlement of numerous coastal communities on the island of Newfoundland and throughout the New World, dating back to the 16th century. Northwest Atlantic groundfish fisheries increased trade and industrialization and began to connect the New World to Europe (Lear 1998). Initially, cod was abundant, despite numerous nations sailing to the northwest Atlantic to harvest the species and bring it back to their home countries. This type of foreign participation in the fishery posed little threat to the stocks compared to what the future would bring. With schooners and inshore boats, powered by sails and oars the impact on the fish stocks was minor. In addition, harvesting was seasonal with fishers coming to Newfoundland in the spring and returning home in the fall with boats full of salted cod. The settlement of Newfoundland

occurred when people were assigned to stay over the winter to protect the stations that had been built along the coast of the island to flake and dry cod (Ryan 1986).

Yields decreased and catch failures occurred in the cod fishery as early as the beginning of the 19th century (Head 1976). When Newfoundland's resident population increased, migratory fishing declined (Lear 1998), and the inshore fishery increased (Head 1976). The reality that primarily inshore and relatively rudimentary technology could cause such a decline in cod stocks should have provided insight for modern management protocols. Later, as transportation and refrigeration technologies improved in the early 1900s, fish markets expanded. Gas powered engines were used in the Newfoundland inshore fishery by 1910 (DFO 1956) and the first commercial trawler was introduced in Newfoundland in 1935 (Lear 1998). For the commercial offshore enterprises, the changes in the fishery were positive. The catches rose and harvesters were able to supply larger quantities of fish in less time. Both commercial and subsistence inshore fishers opposed the large trawlers, arguing that these methods would reduce the number of people employed by the fisheries as well as detrimentally affect the migratory stocks (Lear 1998[4]). However, concern surrounding the status of the resource base and the consequences of the new technology were minimal; the focus was on catching fish and making money.

Voices were raised in concern about the abundance of cod stocks in the northwest Atlantic as early as the late 1800s. However, not much attention was paid to the matter, and biological productivity increased in the 20th century, alleviating any lingering

[4] See also Miriam Wright's A Fishery for Modern Times for additional information and perspectives on the industrialization of the Newfoundland fishing industry.

concern. By the 1940s there was little evidence of overfishing. Apprehensions arose again after the Province's confederation with Canada in 1949. Fisheries regulations became a matter of federal jurisdiction, and Newfoundland and Labrador was concerned about the impact foreign overfishing would have on the Province's primary fisheries resource. The 200 mile EEZ declared Canada's sovereign rights over exploiting and discovering marine resources inside this area. It is believed by many that foreign overfishing before 1977 played a significant role in the declines in cod stocks. Many hoped that the EEZ would be a solution to the problem (Rose 2007).

Unfortunately, the problem was much larger than generally realized and calls for conservation for many groundfish stocks in the 1970s, including cod and redfish, were largely ignored. In fact, little changed in the cod fishery until 1992, when the Honourable John Crosbie, then Minister of Fisheries, announced a two year moratorium for the northwest Atlantic cod stocks. It was believed that the moratorium would only last a few years before a return to normalcy. Fishery participants were divided in their reactions to the closures. Although it is fair to say that all were disappointed, some made concerted efforts to enter other fisheries in the meantime. But fewer participants than expected left the fishery. With no end in sight for the cod moratorium, attention turned to other species that could replace cod in supporting employment and income levels in the fishing industry.

On the face of it, harvesting methods for redfish appear to make them an ideal candidate for diversification since they are similar to those used in other groundfish fisheries. Since redfish are known to be a deep-water fish, deep-water trawler nets were used to harvest them from the start. Eventually, it was discovered that redfish make

diurnal vertical migrations at night, which means that they rise off the ocean bottom in search of food (Pikanowski et al. 1999). This information changed the fishing strategies for redfish, and harvesters began fishing for redfish 24 hours a day using mid-water trawlers (Kelly et al. 1972; Dawe 1976). The use of mid-water trawlers began to create a type of fleet separation in the redfish fishery since it was not economically viable or physically possible for smaller trawlers to use this gear. This posed severe disadvantages to smaller vessel owners in the form of increased costs associated with gear damage, significantly smaller catches than the larger boats, and an increase in cod bycatch when such mid-water trawlers were used. Similar to the experiments that handled the small redfish bycatch problem, cod bycatch was addressed in studies conducted by the Department of Fisheries and Oceans (DFO) in 1993. Semi-pelagic trawling was suggested as a substitute for bottom trawling when large amounts of cod are present on redfish fishing grounds. This method allowed harvesters to fish for redfish that were off the bottom of the ocean floor using the bottom trawling gear already outfitted on the boat, avoiding the added cost of purchasing an entire mid-water trawling system. The use of a net monitor was also suggested which could improve the catch substantially while combating the juvenile cod bycatch problem (Hearn 1993).

Finding alternatives to the declining groundfish stocks in Newfoundland continues to be a priority because of the historical importance of the fishing industry. Newfoundland was built around the fishing industry and small outport fishing communities continue to dot the coastline of the Province. However, fluctuations in resource abundance or market demands create an unstable financial situation, particularly detrimental when a region relies so heavily on one industry.

It has been argued in this paper that the redfish fishery's mismanagement and biological characteristics make it a precarious contender on which to rely in order to help solve the fisheries crisis in Newfoundland. Examining the fishery's potential from the viewpoint of a rural community further supports the claim that redfish are not suitable for this endeavour.

4.1. Gaultois: a community attempt at redfish diversification

Gaultois is a community on the south coast of Newfoundland (Figure 10) that has a decades long history embedded in the groundfish fisheries. Located on Long Island, Gaultois is a 20 minute ferry ride from the community of Hermitage. It is a community truly dependent on the sea and its resources, possessing a rocky and sloping terrain that limits agriculture and construction on the island. The fish plant opened in 1952. It is Gaultois' primary connection to the sea and represents its only industry (Central Newfoundland Tourism 2001). The plant has helped build the community and 95 percent of the workforce population was employed by the plant in 2006[5].

Operations at the fish plant have fluctuated over the years, with management changing hands a number of times and access to raw materials wavering. Since the cod moratorium, the plant has suffered from these fluctuations. Redfish became the chief product for the plant in 1982, the same year it was restructured[5]. Fishery Products International (FPI) acquired the plant in 1987 and controlled it until 1991, when the company consolidated and closed many of its plants in Newfoundland due to lack of raw

[5] See footnote 3 on page 12 (Murray Ingram).

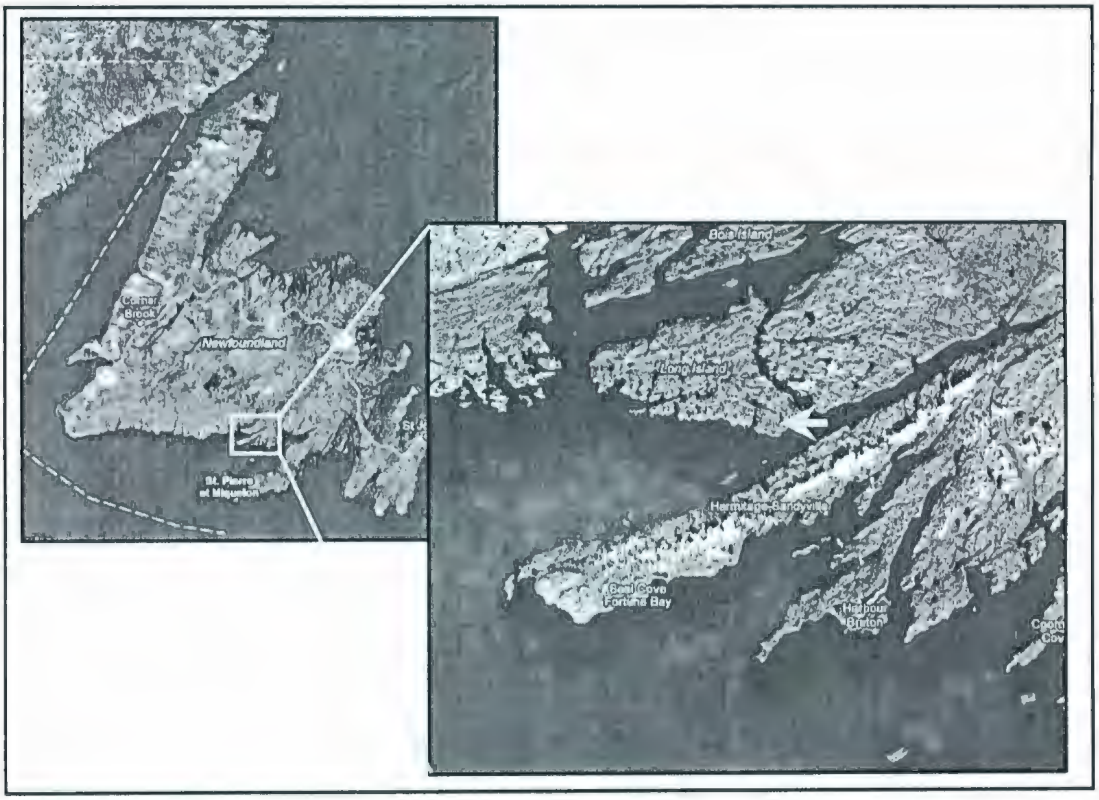

Figure 10. Map of Newfoundland with community of Gaultois highlighted.
Source: Google maps.

material. During this period, the plant operated six months of the year processing primarily redfish. Three offshore stern trawlers were built for the Gaultois operations and first used in 1988[6]. However, after consolidation FPI passed the plant over to the community of Gaultois but took with them the three stern trawlers and five offshore licenses[3]. With virtually no product to process, residents of Gaultois had no means of employment. The Minister of Fisheries then helped Gaultois acquire three offshore licenses so that the plant could process redfish. Without this effort, the community would not have survived[3].

Because redfish were already the primary species processed in Gaultois, diversification took a slightly different form. With most other areas in the Province losing access to cod resources, it was essential for Gaultois to maintain a stake in the redfish industry in the face of plant closures and the departure of the trawlers and licenses. Gaultois needed to acquire enough raw materials to keep the plant operating regularly to avoid out-migration of the majority of its inhabitants. One of the main goals of the Fisheries Diversification Guidelines (Newfoundland Department of Fisheries and Aquaculture 2001) was to "address fisheries diversification as a key opportunity for long-term economic growth, particularly in rural areas". Gaultois qualified for this type of support necessary to maintain participation in the industry.

Without the presence of a major fish processor with substantial financial clout, the Gaultois fish plant struggled for years. Declines in all groundfish stocks affected the entire Province but had the strongest impact on communities like Gaultois, composed of ageing residents with little opportunity for work outside the fishing industry. The cod

[6] John Henry Day, former shore captain in Harbour Breton. Personal communication. 20 February 2007.

moratorium had eliminated a major resource that had been the backbone of Newfoundland for centuries. The closures of two important redfish stocks in 1995 and 1997 compounded the problem. The Unit 1 closure in 1995 was especially debilitating for Gaultois as this stock supplied larger redfish for the plant[7]. As noted above, redfish are currently harvestable at 22cm (DFO 1997), and the larger specimens are typically more valuable for processors. Uncertainty about the state of the resource made potential financiers cautious of investing in the plant for fear of insufficient returns on investments.

After FPI left in 1991, the Gaultois Investment Corporation (GIC) took over ownership of the plant. The operator of the plant has since changed hands. In 2007, GIC still owned the plant but it was operated by GB Seafood International, a Korean-based company[8]. The processing industry in Gaultois has experienced both wage disputes (Cleary 1991), and a lack of redfish quota to provide work for employees and also to attract operators for the plant (Lee 1990; Bungay 2001). Originally, the offshore redfish quota was controlled by the operator of the plant. When the operator left Gaultois, they would take a portion of the quota to offset any losses incurred from the failed business venture. Every time an operator would leave, the Gaultois fish plant would lose more access to redfish quotas. Eventually, the GIC was given control of the quota so that if another company withdrew from the Gaultois operations, the community and the fish plant would not lose access to the stocks. With control of the quota, the GIC had the ability to attract potential new investors[9].

For Gaultois, keeping the fish plant open and operating is the community's only means of survival at present. With no other large company on the island, work is limited

[7] Max Taylor, Chairman of Coast of Bays. Personal communication. 12 April 2007.

to the plant. Gaultois now relies on the redfish fishery, but suffers competition from other processing plants throughout the island of Newfoundland and because other species declined. Currently, redfish contribute more to the community than cod because of the larger volume harvested, although the price per kilogram is lower for redfish[7]. Gaultois is attempting to expand the capacity of the plant to avoid excessive dependence on one species or product. Diversification into other species not previously processed at the plant has been considered. However, a proposal to process whelk, sea cucumber, and sea urchin, commissioned by GB Seafood International in December 2006, was rejected by the Fish Processing Licensing Board and the Minister of Fisheries and Aquaculture[5]. The situation in Gaultois further supports the notion that the northwest Atlantic redfish fishery, in its current state, can not offer a solid alternative to the groundfish fisheries crisis in this region. Although the redfish stocks may be in a state that can support some communities like Gaultois, to continue harvesting and processing, the fishery can not be exploited by increasing numbers of harvesters if it is going to remain at sustainable levels.

5. Conclusions

Redfish do not have an inherent problem that makes them completely unsuitable for diversification. It is decades of mismanagement that has undermined redfish profitability and sustainability. But let it be understood that this mismanagement was not caused by blatant negligence. Rather, the complexity and uniqueness of the species led to the implementation of strategies that neglected to fully take into account how redfish differ from other groundfish species. There is evidence of mismanagement outlined in this paper, including closures of redfish stocks, discrepancies between TACs and landed

catch, and a passive approach regarding management protocols reflecting redfish biology and life history. The closures of two redfish stocks are examples of action taken too late. Examining the relationships between the TAC and the landed amounts of redfish for different redfish stocks over the years portrays a sense of disregard concerning the state of redfish stocks. Additionally, the Newfoundland fishing industry was ill prepared to make such a drastic switch from one species to another, and the redfish resources in the area could not support the added pressure. If complete closures of cod stocks could have been avoided, participants in the redfish fishery and other groundfish fisheries would have been better prepared for adaptation and diversification, either within the fishing industry or into other industries. Decreases in quotas are easier to adapt to than abrupt closures. Discussions a year or two in advance did little to make industry participants understand the magnitude of the crisis and its consequences. Dialogues should not only concern conservation strategies, but should also include economic and social policies that will help people relying on a collapsing species. The cod moratorium was originally supposed to last just two years. Promised government assistance and the notion that the closure was a temporary situation created passivity in many harvesters. When the fishery remained closed for 15 years, it was too late for some to move into new industries or job markets.

Another issue involves redfish policy and management approaches. Aside from the disregard of the species' unique life history, many of the changes made to redfish policy and management occurred only after stocks experienced drastic declines. The data provided in this paper showing the discrepancies between TAC levels and landed catches is one example of mismanagement. On the other hand, it is not to say that a well

managed resource is not subject to collapse. Managers and policy makers can implement plans that are based on the best understandings, practices, and scientific information. There are many factors out of human control, including environmental influences. However, in the case of redfish, more caution should have been exercised. If the precautionary approach had been applied to redfish regulations 30 years ago, perhaps complete closures of particular stocks could have been avoided. Management protocols should be based on life history knowledge of each species and should be conservative in nature if long-term exploitation is the primary goal. The habitat and life cycle need to be considered when developing management and recovery strategies. In addition, the redfish fishery needs to be considered as one that is plagued with uncertainties, and management protocols should be developed that reflect this (Stefansson and Rosenberg 2005).

With the closures of the two stocks in the 1990s, the redfish fishery concentrated on a recovery plan for many of the management units. Unfortunately, recovery is much more difficult for slow-growing and long-lived species like redfish (Hutchings and Reynolds 2004). Alleviating the pressure on redfish is crucial to a sustainable fishery. The two closed stocks have not shown signs of improvement (DFO 2005; DFO 2004) and remain closed to directed fisheries twelve and ten years after closures were implemented. Closures seem to be last-ditch efforts to save a stock rather than a tool of timely management. However, long-term closures are necessary for the recovery of declining stocks, especially for long-lived species (Caddy & Seijo 2005). In terms of management and policy, moratoria need to be coupled with alternatives that aid in maintaining social and economic stability because many overfished stocks show little or no signs of recovery

decades after collapse, and closures, although helpful, will not bring immediate recovery (Hutchings & Reynolds 2004).

Although efforts are being made, because of the low value of the species and the closures of two important redfish stocks, far less attention is being paid to the status of redfish compared to cod. Some argue with good justification that cod science is getting inadequate attention to this day (Rose 2007). It must also be recognized that the number of people interested in the status of cod and the cod fishery is far greater than those paying attention to the state of redfish stocks. Yet, given the current policy focus on diversification and sustainability, research on redfish warrant more attention than it is receiving. Redfish stock status updates were suspended in 2002 due to priority work in other DFO Science projects (FRCC 2003). Currently, the Division 2+3K stock is still at a low level but is showing some improvement in recruitment (DFO 2005). Unit 1 redfish are also still at a low level and are showing no strong year classes for juveniles (DFO 2004). It is essential to have committed and consistent surveys to properly estimate the abundance of both opened and closed stocks in order to effectively manage the resource for sustainability and recovery. In addition, recommendations have been offered to combat the declines of the redfish stocks. The FRCC has recommended that a working group be formed to investigate whether redfish in Units 1 and 2 can be considered as one stock. The FRCC also suggested a follow up on research conducted for the Redfish Research Multidisciplinary Research Zonal Program concerning seal predation on redfish.

The community of Gaultois has relied on redfish resources to keep its plant running for the past two decades. It seems that this region was well-equipped to handle the cod moratorium. However, in 1992, with cod resources unavailable and the loss of

FPI and three stern trawlers, Gaultois began an uphill battle to survival. This leads one to wonder about the potential and sustainability of the redfish fishery in the northwest Atlantic. Gaultois was already harvesting and processing redfish. It seemed that if anyone could make diversification into redfish successful, it would be this community. But the failure of this endeavour had nothing to do with Gaultois, or the fish plant or its employees. Political influences and ramifications from the collapse of cod caused the entire Province of Newfoundland and Labrador to look toward other species. Quick fixes were imagined and implemented before anyone had time to learn from past mistakes. Redfish stocks could not handle the increase in exploitation. This case study, however, further questions the possibility of a sustainable redfish fishery in the northwest Atlantic, one that considers not just the lifespan of the resource and the monetary benefits, but also that of the community and the people directly affected by its abundance or depletion, and draws attention to what is needed to make diversification successful.

Among the possible species that may be suitable candidates for diversification, redfish would be low on the list. This is supported by information and evidence provided in this paper. In addition, relying on a single species for the majority of a quota or income is a dangerous endeavour. This is evident from the experience with the rise and fall of the cod fishery in the northwest Atlantic. A multi-species approach to fisheries resource development is a much more cautious and responsible method of exploitation. Alleviating pressure from one or two key species to exploit a multitude of different resources decreases possibilities of collapse. Likewise, if collapse of one species were to occur, there would already be other alternatives in place. A multi-species approach

allows prices and abundance of species to fluctuate with less fear of complete reinvention of the industry in the wake of a collapse.

There are many things that are important for successful fisheries diversification. On the economic side of the equation, the species should have a relatively high value and the product must be of the high quality demanded in the markets. Biologically, the species must have a strong and well understood resource base that can handle sustained exploitation. Intense exploitation and improper management were key factors to declines in redfish, but the lacking knowledge and disregard of the life history of the species have contributed to the decline and hindered the recovery. Presently, redfish do not offer a feasible cure to the fisheries crisis. Far from presenting a diversification solution, the redfish fishery is arguably in a state of crisis itself. This conclusion, however, does not mean that all hope is lost. What needs to happen first is to bring redfish stocks back to sustainable levels. One obstacle to this is time. Policy makers must realize that this will not fix itself overnight. We need to look at the bigger picture and take seriously the damage to ecosystems that come from endangering the sustainability of key species. If resource policy continues to be made with reference to the potential negative political fallout, we will continue to stumble from crisis to crisis. Fisheries management will far too often continue to be synonymous with crisis management rather than exhibiting the foresight that characterizes responsible inter-generational resource utilization. Redfish can offer a viable fishery and be a leader in the fishing industry in the northwest Atlantic. An essential component to successful diversification and successful exploitation of any species is sound management. Other similar species (i.e. orange roughy) are managed

sustainably around the world. However, it takes patience and a strategy that is as unique as the fish itself.

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