Precautionary management of *Cucumaria frondosa* in Newfoundland and Labrador, Canada

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SUMMARY

The sea cucumber *Cucumaria frondosa* has been reported almost circumglobally in the high latitudes of the northern hemisphere. The earliest fisheries emerged in the late 1980s in Maine (United States of America), and exploitation has only started in the past decade or so on the eastern coast of Canada. This chapter highlights the unprecedented efforts made by the provincial government of Newfoundland and Labrador to implement ecosystem-based guidelines at the onset of this emerging fishery, under the Canadian New Emerging Fisheries Policy. Mandatory information required before the commercial exploitation can be sanctioned include scientific data on the standing stocks (e.g. density, abundance), and on the biology of the species (e.g. reproductive cycle, size at sexual maturity, growth rate, predatory pressure). The present document outlines the rationale and objectives of the New Emerging Fisheries Policy, and the contributions made to date by the main stakeholders wishing to develop a sustainable fishery for *C. frondosa* in Newfoundland and Labrador.

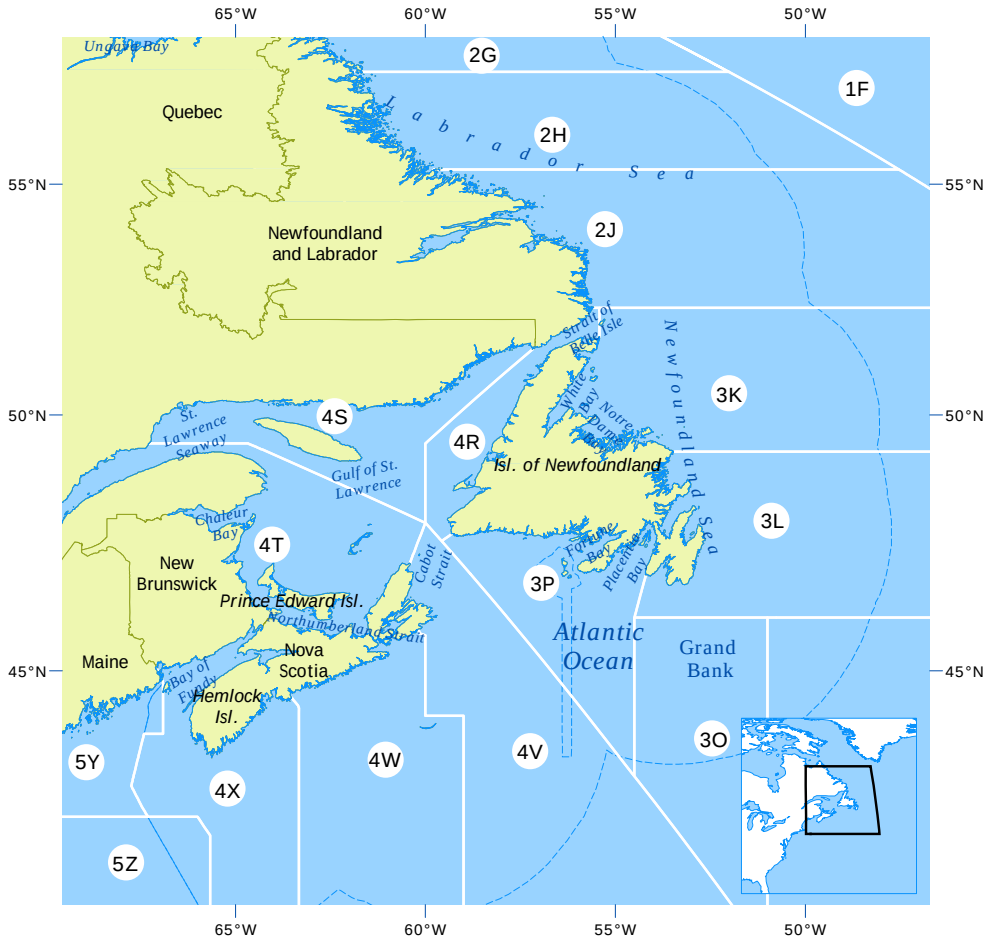
1. INTRODUCTION AND HISTORICAL PERSPECTIVE

This chapter is unique compared to other hotspots covered in the present document. Instead of identifying and discussing an area where sea cucumber fisheries are particularly important, threatened or otherwise affected, this section will present the case study of the province of Newfoundland and Labrador (Canada), where an exemplary management policy is being implemented before opening a commercial fishery for the sea cucumber *Cucumaria frondosa*.

The area under study (Figure 1) is a historically well known fishing ground that has suffered from mismanagement at the regional and international levels in the recent past (Steele, Andersen and Green, 1992; Finlayson, 1994; Hannesson, 1996; Hutchings, 1996; Sinclair, 1996; Walters and Maguire, 1996). While the Grand Banks that lie south of the Canadian island of Newfoundland have enjoyed a great popularity ever since the colonization era (it is alleged that when John Cabot sailed by in 1497, cods were so abundant they could be caught with a basket) the past half century has taken its toll on the seemingly bottomless resources.

In the aftermath of World War II, the famed fishing area saw harvesters from more than two dozen nations regularly join with Canadians and Americans in search of various fish species. This intense pressure and the use of increasingly sophisticated fishing technology soon threatened to decimate most of the once abundant fish stocks off Canada's east coast. Despite early conservation efforts, which included the creation of the International Convention for the Northwest Atlantic Fisheries (ICNAF) in 1949, Canada's claim to a 200-mile economic zone in 1977 and the ensuing reduction in foreign fishing, resources continued to suffer. Even as the yields reached a historic high on the east coast in the early 1980s, Canadian scientists were advising the implementation of a total ban on fishing of certain species (i.e. capelin and cod) on the Grand Banks. The advice was not heeded. Moreover, members of the Northwest Atlantic Fisheries Organization (NAFO), formed in 1979 to replace ICNAF, were

FIGURE 1
Map of eastern Canada showing the area under study and the NAFO subdivisions



dissatisfied with their quotas inside the 200-mile zone and therefore turned to the Nose and Tail of the Grand Banks outside the limit, registering their vessels in non-NAFO countries to bypass international rules. Between 1986 and 1991, non-NAFO vessels allegedly caught more than 200 000 tonnes of fish in areas outside Canada's jurisdiction, which were important nursery grounds for a variety of species. Furthermore, from 1986 to 1992, the European Union set its own quotas and reportedly caught five times the NAFO quota.

While Canada feared and criticized overfishing by foreign fleets, it also ignored warnings from its own scientists and an independent assessment of the northern cod stocks which stated that the resource was threatened and fishing should be reduced. Canada and other NAFO members still maintained their quotas from fear of generating unemployment that would have eventually shut down the industry. However, by 1992, with the collapse of several fish stocks becoming imminent, the Canadian Government implemented major quota reductions that effectively closed down much of the fishing industry in eastern Canada. In 1994, the introduction of the Coastal Fisheries Protection Act empowered the Department of Fisheries and Oceans (DFO) officers to board and arrest foreign vessels in violation of conservation measures. NAFO eventually agreed to a partial ban on some stocks, but to this day many fishing nations are still uncommitted to the principle of sustainable development. Meanwhile, strong of lessons hard learned, Canada is steering toward ecosystem-based precautionary approaches to improve fisheries management. This new vision is crucial to Newfoundland and Labrador, where the marine resources and the fisheries that they sustain are considered a dynamic and significant component of life, affecting communities and rural areas throughout the province. This vital sector is evolving to include a broader base of species and activities, including aquaculture, sport fishing and value-added processing, all aiming to create a vibrant, self-sufficient and sustainable industry in coastal and rural communities.

One of the main lessons learned by Canada over the past decades is that insufficient biological knowledge of a species can seriously impede its sustainable management (Walters and Maguire, 1996). A key objective is therefore to implement a precautionary approach and support the collection of sound scientific data before authorizing any new fisheries at the commercial level. This novel approach is described under the "New Emerging Fisheries Policy". While it presents appealing goals and expectations on paper, actually enforcing this new policy requires an exceptional and unusual collaboration at various levels of the hierarchy to include harvesters, scientists, the private sector and government authorities. For this reason, it has taken several years for anything concrete to unravel. Among the unexploited or underutilized marine species that thrive off the Canadian east coast, and specifically around Newfoundland and Labrador, sea cucumbers *C. frondosa* have been identified as a target resource and were therefore recently listed under the Emerging Fisheries Policy.

The next sections will present information on how Newfoundland and Labrador is preparing its new sea cucumber fishery. Detailed data on *C. frondosa* (i.e. population status, landings and management, trade and socio-economic importance) have already been provided in the chapter "Population status, fisheries and trade of sea cucumbers in temperate areas of the Northern Hemisphere" and consequently only a few relevant data will be summarized here for the sake of clarity. This will be followed by a description of the "New Emerging Fisheries Policy". The whole initiative and the preliminary results compiled at various levels (i.e. government, academic, private sector and fishing industry) will be evaluated and discussed. Finally the chapter will close by reflecting on the policy and whether or not CITES listing could assist in the development of good management practices to avoid overfishing and promote conservation of sea cucumber populations in eastern Canada.

2. THE SPECIES

The sea cucumber *C. frondosa* is the only species of temperate-polar holothurian with commercial interest that can be harvested along the eastern coast of North America. Although the harvest of *C. frondosa* is still at the exploratory phase in most areas, a commercial fishery with recorded landings began in 1988 in the state of Maine (United States of America). Despite local management efforts, signs of overfishing are already being reported along the coast (Bruckner, 2005; Hamel and Mercier, this volume). The rapid development of the sea cucumber fishery in Maine has raised a question similar to the one addressed by the new emerging fisheries policy in Canada: "How should we be harvesting this resource to ensure a continuous supply in the future?" The answer will be difficult to ascertain. Just as the sea cucumber has been ignored as a commercial product in the past, it has been ignored as a subject of study by fishery scientists. Our knowledge of the biology of most sea cucumbers and how their populations will respond to fishing is rudimentary at best.

The main difference this time in Newfoundland and Labrador is that the authorities will have the tools and means to evaluate this fishery before its onset, an exemplary mode of management based on good science and respectful harvesting practices. The challenge is to gather everyone around the same table in order to design a plan of action, to find the funds, to achieve the objectives, and finally to translate the results into management practices.

3. MANAGEMENT SCHEME

3.1 New Emerging Fisheries Policy

In Canada, this policy applies to all new fisheries undertaken in marine or freshwater areas where the DFO manages the fishery. Aboriginal communities retain their constitutional right, second only to conservation, to fish for food, social and ceremonial purposes. Box 1 summarizes the key contents of the "New Emerging Fisheries Policy" published in 2001 to replace the "Emerging Fisheries Policy" established 1997[1].

3.2 The case of *Cucumaria frondosa*

The significant decline experienced by traditional fisheries in Canada has created opportunities for the study of several new and emerging species. So far, very few species have been identified under the New Emerging Fisheries Policy. In the Maritimes, common whelk fisheries are being developed using some level of precautionary measures. Other fisheries (e.g. toad crab, rock crab, shrimp beam trawl) have also been managed pursuant to the policy as it came into effect in 1998, though they did not benefit from the thorough science that is now being applied. The case of *C. frondosa* in Newfoundland and Labrador appears to be unique, with only the Atlantic hagfish being developed under comparable guidelines.

As soon as the commercial potential of *C. frondosa* was identified by the Department of Fisheries and Aquaculture (DFA) of the Government of Newfoundland and Labrador, an exemplary collaboration was established at all levels in order to work efficiently toward the success of the emerging sea cucumber fishery. The ultimate goal is to acquire data deemed necessary by the DFO to make a guided decision concerning this resource. Sustainability for future generations is at the heart of current preoccupations. To achieve this goal, the DFO, the DFA, the Marine Institute (Memorial University), the Ocean Sciences Centre (Memorial University), the Canadian Center for Fisheries Innovation (CCFI), the processing industry (fish plants) and numerous harvesters are joining hands in an unprecedented effort to promote a new way of managing the fishing industry in Canada, specifically in Newfoundland and Labrador. Below is a summary

[1] http://www.dfo-mpo.gc.ca/communic/fish_man/nefp_e.htm.

of the work conducted so far and the studies that still need to be completed before the official opening of a commercial sea cucumber fishery in this Canadian province.

For the sea cucumber *C. frondosa* everything began in 1988 as a small fishery emerged on the east coast of the United States of America. This fishery developed rapidly because of demand from foreign markets. Sea cucumbers are harvested using a bottom trawl gear similar to the one used in the scallop fishery; vessels are typically between 13 and 30 m in length. Landings for Maine increased from 2 900 kilograms in 1990, to over 4.3 million kilograms in 2000, and then dropped to 1.5 million kilograms in 2001. The highest value recorded was USD 614 937 in 2000. In Atlantic Canada, *C. frondosa* is mainly harvested as a result of bycatch from scallop fisheries between May and November. In 1992, the Resource Development Associates (RDA) prepared a proposal following discussions with the DFO concerning a significant biomass of sea cucumbers which had been identified in nearshore Newfoundland waters. This first approach defined a broad objective to undertake a preliminary assessment of market potential for *C. frondosa* in selected target markets (RDA, 1992).

In 1997, the Canada/Newfoundland Cooperation Agreement for Fishing Industry Development (CAFID) carried out an exploratory sea trial for sea cucumbers in the province and concluded that this species had potential based on biomass and accessibility of the resource. In 2002, the DFA, under the Fisheries Diversification programme, surveyed prospective sea cucumber fishing grounds and alternative harvesting methods. This study estimated that certain areas of the province could maintain a viable industry and recommended that alternative methods of harvest be used, such as a modified beam trawl, green sea urchin drag and modified Labrador scallop buckets.

Between 1997 and the early 2000s, the DFO and the DFA surveyed several areas along the coast of Newfoundland and Labrador for sea cucumbers, tested different harvesting methods and investigated ways of minimizing bycatch (Figure 2).

Since then, there have been a number of companies who have carried out preliminary processing and marketing studies of *C. frondosa*. In 2001, new funding was approved through the Fisheries Diversification Programme to conduct sea cucumber surveys in various areas of the province: dive harvests in Notre Dame Bay; scallop bucket harvests in St. Pierre Bank, Placentia Bay and Labrador (DFA, 2001). During 2002, Fogo Island Co-op processed upwards of 160 000 kilograms from the dive harvest fishery in the Notre Dame Bay and Bonavista Bay areas and from a towed gear fishery along the Burin Peninsula. Efforts toward the development of a sea cucumber fishery continued in 2002 with three projects completed by DFA Fisheries Development Officers. These projects included two dive harvest projects and a tow gear design and testing project. The dive harvest studies were carried out in Bonavista Bay and Notre Dame Bay while the tow study was conducted at Dantzic Point and near Fortune and St. Pierre

FIGURE 2
Scientific surveys carried out jointly by the Department of Fisheries and Oceans and the Memorial University on St. Pierre Bank, Newfoundland and Labrador, Canada

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BOX 1

The Canadian New Emerging Fisheries Policy

The New Emerging Fisheries Policy was developed to clearly lay out the requirements that must be met and the procedures to follow before a new fishery can be initiated. A cornerstone of the new policy is provision for the establishment of a scientific base with which stock responses to new fishing pressures can be assessed. Not only does the Emerging Fisheries Policy provide applicants with a transparent process to follow, it also gives DFO managers a procedure that can be applied fairly and consistently. This policy is also precautionary in its approach to the development of new fisheries. The objective is to diversify fisheries and increase economic returns while ensuring conservation of the stocks and realizing the sustainable use of fisheries resources. These new guidelines are not restricted to sea cucumbers or to Newfoundland and Labrador; they apply to all prospective species throughout Canada.

The New Emerging Fisheries Policy is guided by the following principles: (i) New fisheries must provide for a reasonable scientific basis for their management. The process by which new fisheries will be managed must include the requirement for stock assessment information in the early stages; (ii) New fisheries should contribute positively to the economical viability of a fishery enterprise on an ongoing basis; (iii) Under the proposed policy all requests from applicants must include proposals that outline research, management and conservation approaches as well as cost of these approaches; (iv) Conservation will not be compromised, a precautionary approach will guide decision making. Information on the abundance, distribution, and productivity of the target species is identified as the key scientific requirement for development of precautionary management strategies; (v) The potential impact or interaction of any new fishery or its gear on associated or dependent species, fishing or gear type and on habitat will be assessed; (vi) Based on biological and environmental information, including input from industry, provinces/territories and the public, DFO will establish conservation standards, set conditions for harvest, and monitor their application; (vii) Users are accountable for compliance with conservation standards for meeting harvesting conditions; and, (viii) In allocating DFO's personnel and financial resources, priority will be given to the research, management and enforcement of established fisheries.

As a general rule, new fisheries involve three stages:

Stage I: The preliminary feasibility stage. (Scientific Licences) The objective of this stage is to determine if harvestable quantities of the species/stock known to be present in a particular fishing area exist, if the species/stock can be captured by a particular gear type, identify multi-species and habitat impacts, if markets exist and, the best approach for proceeding further, e.g. to Stage II.

Stage II: The commercial and stock assessment stage. (Exploratory Licences) The objective of this stage is to determine whether a species/stock can sustain a commercially viable operation and to collect biological data in order to build a preliminary database on stock abundance and distribution.

Stage III: The commercial fishery stage. (Commercial Licences) This stage is reached once it has been determined that a species/stock can sustain (commercially and biologically) commercial fishing operation. A formal Integrated Fisheries Management Plan is introduced.

The preliminary assessment (Stage I)

Applicants will submit proposals/applications that: (i) identify the target species/stock, fishing area and fishing method for which a licence is requested; (ii) summarise current knowledge about the target species, and provide an indication of how other species and/or the environment might be affected by the proposed activity; (iii) provide a detailed plan

outlining proposed fishing activities, e.g. applicable inspection requirements, harvest level by management area, harvesting method to be used, vessels to participate, start-up time, duration of harvesting activity, interactions with other fishing activities; (iv) provide information of product use, e.g. product forms, on-board product forms, onshore production if any, likely market distribution; (v) provide proof of public notification/consultations which allows for industry/public review and input; (vi) successful applicants must, in consultation with DFO, prepare a catch and effort record system; and (vii) identify sources of funding.

NOTA: 1. Applications to access new fisheries for which existing licences have been issued and for which no new licences are being issued because they are fully subscribed or where overcapacity will not be considered.

NOTA: 2. All new fisheries for which Stage I activity has been completed and for which applications/proposals are being sought for additional licences for Stage II activities should be communicated publicly by DFO in a regional press release.

The commercial and stock assessment (Stage II)

An exploratory harvesting strategy for the new fishery, including number of licensees, access criteria, including, where applicable, regional/provincial distribution, catch monitoring and reporting strategy, bycatch limits, seasons, etc., will be developed by DFO or a Committee.

1) In consultation with DFO Science, prepare a protocol to be used for the stock assessment component of the new fishery broken down as follows: data collection, data analysis, data recording and report preparation. The following additional information will be required for applications involving new fisheries at the commercial and stock assessment stage (Stage II).
2) The proposed processing and marketing strategies, including product forms, plants to be used and market destinations.

Upon the receipt of applications for new fisheries, the DFO is responsible for initiating a review of all applications for new fisheries. If the number of qualified applicants exceeds the number of licenses, a selection process will take place.

The licensing process (Stage III)

Once a decision on licensees for a new fishery is made, the Department will initiates new fisheries as follows:

1) Licence conditions for the new fishery are established, including, fishing areas, season, gear restrictions, licensing period, gear-up deadline, by-catch limits, etc.
2) The responsibilities of the licensee with regard to scientific, enforcement and/or management responsibilities and associated costs, as outlined in the exploratory harvesting plan, are included in a Memorandum of Agreement (MOA) or where appropriate as conditions of licence.
3) Successful applicants are notified of their selection and advised that issuance of licences is subject to receipt of a signed MOA by the Department.
4) Once signed MOAs are received by the Department, licences are issued to participants as follows: scientific or experimental licences for Stage I new fisheries and, exploratory licences for Stage II new fisheries.
5) Participation requirements will be introduced as a condition of exploratory licence issuance.
6) DFO will be responsible for analysis of information received from Stage I and II in a timely fashion so as to provide information base for assessing progression to further stages.
7) Scientific licence holders (Stage I) will be given priority for exploratory licences (Stage II).
8) Exploratory licence holders (Stage II) will be given priority for regular licences (Stage III).
9) Scientific/experimental or exploratory licences are not reissuable between individuals.
10) The names of successful applicants are released.

Bank (DFA, 2002). At this point it was mentioned that an environmentally friendly and acceptable method of harvesting should be used to establish the extent of the sea cucumber resource. DFA (2002) reported that dive harvests could be around 900–1 400 kg day^{-1}, this method being much less destructive than the results obtained with the towed gear (scallop gear) used to catch the sea cucumber, which also captured a wide variety of non-target species such as crabs, sea stars, sea urchins, molluscs and fishes.

DFA also looked at the Strait of Belle-Isle in 2003 (DFA, 2003) and again in 2004 (DFA, 2004a). The gear tested allowed to catch up to 375 kilograms of sea cucumber in 15–20 minutes tows. Also in 2004, the fishers and the DFA explored other areas including the southern coast of Labrador with surveys to determine if sufficient quantities of sea cucumbers could be found to sustain a commercial fishery (DFA, 2004b). The results obtained were not satisfying enough to warrant further studies of this species inside the survey areas.

The harvesting of sea cucumber began in Newfoundland and Labrador in 2002 with most of the effort concentrating on Newfoundland's Northeast Coast (DFA, 2004a). The fishery has been slow to develop mainly due to the lack of knowledge relative to resource abundance. Initially, dive technology was used to identify areas of concentration of this species. In 2002, a drag gear technology was transferred to Newfoundland and Labrador from Maine (United States of America) and proved to be very effective with improved catch rates particularly on the St. Pierre Bank.

In 2003, the project refined its target with a sea cucumber resource survey in NAFO subdivision 3Ps (Figure 1) in waters deeper than 20 m, as defined in the Emerging Fisheries Exploratory Sea Cucumber licence condition issued to the participating fishers.

The DFO, the fishers and the Fish, Food and Allied Workers have agreed to jointly undertake scientific survey work supporting the development of a commercial sea cucumber fishery in the NAFO area subdivision 3Ps. This Joint Project Agreement (JPA) is a five year project to be completed by 31 March 2009. The objective from the participants perspective is to: (i) collect reliable scientific information to assist science in carrying out a stock assessment and enable resource managers to make informed decisions for the effective management of an economically and biologically sustainable commercial sea cucumber fishery; and (ii) help the industry acquire knowledge of sea cucumber harvesting, processing and marketing to enlighten the decision making process required within a commercial fishery. The objective from a resource management perspective is to ensure that the industry actively participates in the development and management of any emerging sea cucumber fishery. Through this agreement, activities will be conducted to assist in the provision of scientific advice that can be used in the development of management strategies and potential implementation of a limited-entry fishery under the auspices of the Emerging Fisheries Policy.

The objective of DFO's science branch is to gain from the surveys reliable information on sea cucumber biomass and distribution in NAFO subdivision 3Ps. This objective will be achieved by acquiring detailed data on locations, catches, bycatches and catch rates, through collecting and processing biological samples, analysing data, and providing scientific advice on an on-going basis.

With the information gathered and compiled, it will then be possible to determine which management tools are appropriate to develop a sustainable and stable fishery for sea cucumber in NAFO subdivision 3Ps.

The paragraphs below summarize the respective roles and goals of the parties involved as defined before the onset of the joint collaboration (after JPA, 2004):

DFO Fisheries Management Branch:

- Provide liaison between DFO Branches and participants in the implementation of the various goal;

FIGURE 3
Harvesters are licensed by Department of Fisheries and Oceans to assist in carrying out the biomass surveys

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The core partners enlisted the help of the Marine Institute of Memorial University (Newfoundland and Labrador) which published a first report in 2004 (Winger, Keats and Grant, 2004). The research found that sea cucumbers were easily distinguishable by camera in the field (through a camera placed on a sledge allowing scientists to see how the net works and which species are captured and in what amount). Investigators also gathered information on substrates occupied by *C. frondosa* in 3Ps: sand, gravel and cobble. They estimated the density between 0.16 to 0.58 ind. m^{-2}.

In May 2004, the Marine Institute of Memorial University, in partnership with DFA, published a report on the quality assessment of the product as per market stipulations (MI, 2004). They also published a report that described a sorting system to allow minimal size categorization and easy exclusion of incidental or bycatch along with the removal of gravel, pebbles and debris (MI, 2005a). There was also an assessment of water-loss in *C. frondosa* upon harvest (MI, 2005b). Yet another study was conducted by DFA and MI on a handling system designed to quickly transfer sea cucumbers from the holding tank to the fish hold, minimizing the effort of the crew in handling the product and helping grade out undersized animals and bycatch (MI, 2006a). Finally, the Marine Institute published results on habitat utilization and density of sea cucumber (Winger, Keats and Grant, 2004; MI, 2006b). The results indicate that *C. frondosa* is capable of colonizing different types of habitat.

A couple of studies were conducted in view of building databases for stock assessment purposes in the St. Pierre Bank and in the Strait of Belle Isle (Grant, 2006; Grant, Squire and Keats, 2006). The reports summarize a large amount of data on the morphology, sex ratio, size at sexual maturity, spawning season and constitutes the first set of biological data available on *C. frondosa* from the St. Pierre Bank and the Strait of Belle Isle since Newfoundland and Labrador initiated their investigation of this new emerging species.

In 2004 the DFA asked Dr Fereidoon Shahidi (Memorial University) to perform a detailed analysis of the chemical composition of fresh and processed sea cucumber from Newfoundland and Labrador (Shahidi, 2006).

In 2005, in his protocol for the new emerging fisheries, DFO scientist Dr Don Stansbury from St. John's (Newfoundland and Labrador) indicated that the review process of the sea cucumber fishery should include a large science component. It was

noted that data relevant to decision making within this new fishery was still sparse, and that fisheries science was important in the development of new fisheries. Information identified as missing included: spatial distribution and abundance (some data gathered during previous surveys were still being compiled), reproduction, development, recruitment, growth, predator pressure on the resources and gene flow.

One of the most recent steps in the process of gathering precise biological data on *C. frondosa*, has been undertaken in 2006 by Justin So (MSc candidate, Memorial University) as part of a project funded by DFA, CCFI and the industry (harvesters/processors). The objective of this new study is to provide answers to some of the as yet unaddressed questions identified by DFO relative to a potential commercial sea cucumber fishery in Newfoundland and Labrador: the growth rate from fertilization to commercial size, the physiological condition of individuals from different habitats (sand, pebbles, bedrock), the pattern of gene flow throughout the distribution range of the species (to determine the impact of larval dispersion and assess connectivity between distant populations), and the influence of predatory pressure, mainly from the sea star *Solaster endeca* on the resource.

3.3 Newfoundland and Labrador compared to other Atlantic Provinces

At this time, Newfoundland and Labrador (NL) has taken the lead in terms of the New Emerging Fisheries Policy where it concerns *C. frondosa*. The province is enforcing the policy in a much stricter fashion than other Canadian provinces currently wishing to develop the sea cucumber fishery. It is however worth mentioning that this may not necessarily be the case for other species with commercial potential which are presently being studied in Canada under the New Emerging Fisheries Policy.

Nova Scotia (NS) and New Brunswick (NB) are both interested in exploiting sea cucumber populations in the North Atlantic, and they have indeed begun accessing this new resource over the past few years. The province of New Brunswick has adopted a much more liberal approach to the Canadian policy relative to emerging resources. In that province, only two sea cucumber harvesters are working under the scheme to provide survey data and they are working over an area of about 5 km^2, from which they extract a total of approximately 1 310 tonnes annually. In contrast, eight harvesters from NL are participating in the study, which is conducted over an area of 5 200 km^2 (i.e. 1 000 times larger than in NB), and the overall quota they share is currently set at ca. 650 tonnes (i.e., roughly half the NB quota).

Because the New Emerging Fisheries Policy is a national initiative, there should not be such inconsistency in the application of the protocol. Canada is therefore looking at standardizing the approach within all its provinces in this domain. But this will certainly prove to be a huge challenge, especially in light of the different views expressed by harvesters and policy makers where fisheries are concerned. It is always difficult to convince fishers to participate in a scientific study during which they are not making any profits, notwithstanding the fact that they will eventually be the ones benefiting from the exploitation of a new resource in a sustainable manner. Nevertheless, Canada has adopted a precautionary approach and policy makers are urged to enforce the new measures as rigorously as possible. This confrontation will be playing out every time the sea cucumber fishery re-opens until April 2009, when the preliminary scientific work will be completed.

4. RECOMMENDATIONS

4.1 General

A new and expanding fishery requires some new structures and processes in management. DFO has a mandate to manage the fishery which should be concerned with maximizing the benefits to the people of Canada. This aspect has been lost in the

ensuing hardships of a decline in fish stocks. Allocation issues have been at the forefront of fisheries management and will continue to be. They can only be resolved with a large amount of goodwill among all parties to the discussion. When these last objectives are completed, and as more data on the biomass becomes available, no later that in 2009, all prerequisites required by the DFO will have been fulfilled. The latest estimates of biomass on St. Pierre Bank (NAFO 3Ps) by the DFO evoke very interesting prospects. With an average CPUE of ca. 300 kg tow^{-1} and an available biomass of about 300 000 tonnes (unpublished DFO statistics, St. John's, NL) the sea cucumber fishery may face a promising future if it is well managed and if the fishers respect the regulations established by the DFO based on their data acquisition.

A success story would certainly set a great example for other species (e.g. box crab, tanner crab, Pacific milky Venus clam, varnish clam, purple sea urchin, sea mussel, neon flying squid, Pacific sardine) which are currently being considered for development in experimental fisheries by the Canadian Government.

4.2 CITES considerations

Is there any advantage in listing *C. frondosa* under the Convention on International Trade in Endangered Species (CITES)? If the development of the fishery follows strict protocols, perhaps not. However, fisheries rarely develop according to plan and the history of sea cucumber harvesting worldwide highlights the likelihood of rapid stock depletion. Thus, despite presumably high biomasses, the perspective of *C. frondosa* becoming a threatened species cannot be discarded completely if a commercial fishery is to be opened. CITES is an established organisation with a sound basis in international law, and experience at monitoring international trade at the species level. It is argued that the lack of solid biological and fisheries data currently constrains conservation and management efforts with sea cucumbers elsewhere. CITES listing could potentially provide better quantitative data on sea cucumbers in trade: species, products, volumes. It is also argued that it could provide improved controls for protecting threatened populations from potential overexploitation. On the other hand, a CITES listing would not reduce bycatch, incidental capture, fisheries targeting national consumption (i.e. non-traded resources), nor the fishing impacts on other species on which sea cucumbers may be dependent.

In the specific case of *C. frondosa* and its exploitation in eastern Canada, little thought has been given to the potential benefits associated with CITES listing. According to DFA Fisheries Development Officer Lewis Barrett, steps could be initiated with relevant government departments and agencies to explore the process for having *C. frondosa* listed in CITES Appendix II, should this precaution become necessary in the near future. He believes that with adequate background documentation, the DFA Planning Branch would probably support such an initiative in keeping with the recent focus and collaborative efforts between DFA, DFO (i.e. involving Canada's *Oceans Act*, Marine Protected Areas [MPAs], etc.), and Environment Canada. Although such a project would surely fall under federal jurisdiction, provincial departments can still review it on merit and decide whether they would be prepared to support it. Especially since it will likely complement the guiding principles under DFO's New Emerging Fisheries Policy in laying the ground work for a strategy that future generations will embrace as an overall "futuristic, positive thinking approach" to reverse the global environmental slide on wild fish stocks. It might well be to the industry's advantage to support and endorse a CITES listing as more and more companies select to abide by new consumer rules and requirements that are identified with sustainable fishing practices. An industry led initiative in this respect would be good and governments would naturally follow suit (Barrett, L., DFA, personal communication).

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- Provide Fisheries Management direction and liaise with DFO Branches and the participants for the duration of the various stages;
- Arrange a public draw, if necessary, for selection of vessels;
- Conduct performance review to ensure project objectives are met;
- Conduct consultation meetings for the development of the Annual Project Work Plans and Management Strategies for this fisheries;
- Monitor fishing practices;
- Prepare post-season analysis and annual report on the project results;
- Meet with industry to discuss study results and future plans.

DFO Science Branch:

- Work collaboratively with the participants toward the determination of essential biological parameters on which to supply scientific advice for management strategies for the sea cucumber fishery and monitor the development and performance of the fishery;
- Assist in the development of project design;
- Review and assist, as necessary, work completed by DFA, the Marine Institute (MI) and others to develop and apply measurements to determine relationships between live weight, drained weight and dry weight;
- Conduct analysis of biological data;
- Analyse fishing logs to chronicle the fishery, including spatial distribution of fishing effort and the changes in catch per unit of effort;
- Monitor fishing practices;
- Prepare annual report on the project scientific results;
- Exchange information and establish dialogue between all parties by meeting with the participants and Fisheries Management;
- Participate in consultation meetings for the development of the Annual Project Work Plans and Management strategies for the fisheries.

The fishers and the Fish, Food and Allied Workers (FFAW):

- Install sea cucumber drags and appropriate gear and equipment necessary to carry out sea cucumber fishery on vessels, as defined by DFO;
- Conduct fishing activities and record data in prescribed areas as outlined by DFO;
- Assist at collecting sea cucumber data in sea cucumber logbooks;
- Adhere to a fishing schedule as agreed upon by the fishers, the FFAW and DFO;
- Maintain minimum and maximum weekly sea cucumber landings as agreed upon by the Fishers, the FFAW and DFO;
- Land at designated ports agreed upon by Fishers, the FFAW and DFO;
- Arrange for dockside monitoring and sampling of sea cucumber to determine live weight at port;
- Exchange information between the parties by meeting with DFO to discuss the survey and project results.

The actual role and objectives of the participants has been modified as other partners joined in the venture and they will continue to evolve before the completion of the proposed three stages.

To our knowledge, the sea cucumber project in Newfoundland and Labrador really began in 2003 as an initiative or JPA between the DFO, the fishers, the FFAW and the Fogo Island Cooperative Society Limited (JPA, 2004). These partners, along with considerable input/contribution from DFA and CCFI, will be leading the project entitled "Sea cucumber resource survey in NAFO subdivision 3Ps" in waters greater than 20 m until 2009 (Figure 3).