Analyzing bycatch mitigation in the MSC-certified Canadian Northwest Atlantic longline swordfish fishery

By

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ABSTRACT

Recent proliferation of market-based approaches for sustainable fisheries management has led to the creation of organizations like the Marine Stewardship Council (MSC). MSC uses its fishery certification programme and eco-label to attract consumers and reward sustainably managed fisheries. Although MSC is succeeding in making seafood more sustainable, it should be recognized that there is a need for improvement regarding bycatch mitigation in many MSC-certified fisheries. This study analyzed the appropriateness of bycatch mitigation conditions and client action plan provided under the MSC certification of the Canadian Northwest Atlantic longline swordfish fishery. The certification of this fishery received significant opposition from environmental non-governmental organizations due to its high levels of shark and sea turtle bycatch. As such, a case study approach was used to compare this fishery with the MSC-certified Southeast US North Atlantic longline and handgear buoy line fishery. These two fisheries were analyzed using a FAO/SMART analysis table, developed to objectively evaluate existing measures for bycatch. This analysis led to several recommendations, primarily relating to the need for the Canadian Northwest Atlantic longline swordfish fishery to develop and implement better methods for data collection. Access to such additional information can potentially permit more specific and effective measures for mitigating bycatch species, and therefore improve the sustainability of this MSC-certified fishery moving forward.

Keywords: MSC, bycatch, Atlantic, swordfish, longline, sustainability

LIST OF ABBREVIATIONS USED

ALPAC: Atlantic Large Pelagics Advisory Committee

ASI: Accreditation Services International GmbH

CAB: Conformity Assessment Body

CAP: Conservation Action Plan

CCTV: Closed Circuit Television

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora

CMM: Conservation and Management Measures

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

CSAS: Canadian Science Advisory Secretariat

DFO: Department of Fisheries and Oceans

ESA: Endangered Species Act (United States)

ETP: Endangered, threatened or protected

FAO: Food and Agriculture Organization (United Nations)

FDA: Food and Drug Administration (United States)

FEC: Florida East Coast

FLS: Fisheries logbook system

HSP: Habitat Stewardship Program

ICCAT: International Commission on the Conservation of Atlantic Tunas

IFMP: Integrated Fisheries Management Plan

IMM: Intertek Moody Marine Ltd.

LCAP: Loggerhead Conservation Action Plan

MPA: Marine Protected Area

MSC: Marine Stewardship Council

NGO: Non-Governmental Organization

NMFS: National Fisheries Marine Service

NSSA: Nova Scotia Swordfishermen's Association

PI: Performance Indicator

PPS: Probability Proportional to Size

RFMO: Regional Fisheries Management Organization

SARA: Species At Risk Act (Canada)

SG: Scoring guidepost

SMART: Specific, Measureable, Assignable, Realistic, Time-related

TAC: Total Allowable Catch

US: United States

UoC: Unit of certification

WCPFC: Western and Central Pacific Fisheries Commission

WWF: World Wildlife Fund

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CHAPTER 1: INTRODUCTION

The global collapse of fish stocks may be partially attributed to poor state policy development and implementation (Owens, 2008). As a result, there has been a recent proliferation of market-based approaches to sustainable fisheries management (Foley, 2012). The Marine Stewardship Council (MSC) is a prime example of an international non-profit organization that uses a consumer directed approach to support and reward sustainable wild fisheries. More specifically, MSC uses a fishery certification programme and eco-label (Figure 1) to inform consumers that MSC-labeled fish products come from responsibly managed fisheries. The MSC Global Impacts Report (2013a) contains findings that confirm the MSC program is succeeding in making seafood more sustainable, having certified over 188 fisheries worldwide. As such, MSC continues to promote the growth of markets for sustainable seafood and foster a culture of eco-consumerism.

Figure 1. MSC logo (adapted from MSC, 2012).

MSC's three main guiding principles are: sustainable fish stocks (Principle 1), minimizing environmental impact (Principle 2), and effective management (Principle 3). Principle 1 states that a fishery must be conducted in a manner that does not lead to overfishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery. Principle 2 states that fishing operations should allow for the maintenance of the structure, productivity, function and

diversity of the ecosystem, including habitat and associated dependent and ecologically related species, on which the fishery depends. And Principle 3 states that the fishery must be subjected to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable (MSC, 2013b).

Within these MSC principles there are specific criteria that collectively form the MSC standard. It is based on this standard that further MSC certification requirements and guidelines are released as part of their fishery certification programme. To maintain transparency and impartiality in this program, independent Conformity Assessment Bodies (CABs) are authorized by Accreditation Services International GmbH (ASI) to conduct third-party assessments. Once a fishery is certified by a CAB, all products that are sourced from that fishery can then bear the eco-label.

Although there have been improvements within the management of commercial or target species through programs such as the MSC, one of the most contentious issues in the management of fisheries worldwide is bycatch (Hall, Alverson, & Metuzals, 2000; Kelleher, 2005; Lewison, Crowder, Read, & Freeman, 2004). This study defines bycatch as an "unintended, unused, inappropriate or unaccounted form of catch" (FAO, 2009, p. 15). Bycatch may be sold, released alive, or discarded dead (FAO, 2010; Harrington, Myers, & Rosenberg, 2006), therefore MSC classifies bycatch into (i) general bycatch species, (ii) bycatch species that are retained, usually due to market value, and (iii) bycatch species that are considered endangered, threatened or protected (ETP), as listed under legally binding national and international agreements. Given the urgency for bycatch mitigation, this study will only focus on MSC Principle 2, specifically the bycatch requirements therein.

According to Christian *et al.* (2013), there have been six MSC-certified fisheries that have received formal objections due to bycatch issues under Principle 2. Among these fisheries is the Northwest Atlantic Canada longline swordfish (*Xiphias gladius*) fishery, which has high levels of shark and sea turtle bycatch. This formal objection came from the David Suzuki Foundation, Ecology Action Centre, Oceana, and Sea Turtle Conservancy, however the certification was upheld (Christian *et al.,* 2013). Therefore, while Principle 1 and Principle 3 are equally important in the certification process, the focus of this study remained on Principle 2 and the bycatch requirements therein.

1.1 Scope of Study

The scope of MSC's initiatives should be recognized, as it only applies to the extraction phase along the entire Chain of Custody. Beyond this phase, MSC only uses its Chain of Custody Standard that certifies a fishery based on the traceability of its products, not accounting for any subsequent discarding or waste that occurs after the extraction phase (MSC, 2013b). Therefore, this study focused on bycatch mitigation within the extraction phase to provide recommendations for the Canadian Northwest Atlantic longline swordfish fishery moving forward. A set of criteria was used to select case studies for comparison with the targeted fishery in order to minimize confounding factors. This resulted in the selection of the Southeast United States (US) North Atlantic pelagic longline swordfish fishery as the most appropriate for comparison. This case study was the only fishery that met all of the selection criteria, however it should not be confused as a model for all MSC-certified fisheries.

The comparative analysis was conducted using FAO (2011) International Guidelines on Bycatch Management and Reduction of Discards and Doran's (1981) SMART criteria. In

addition to using FAO guidelines and SMART success indicators, the following research questions were used to guide this study:

1. What deliverables are lacking under Canada's longline swordfish certification (if any)?
2. What deliverables under the US' longline swordfish certification should be applied to Canada's longline swordfish certification (if any)?
3. What improvements need to be made to Canada's longline swordfish certification beyond those from question 2 (if any)?

Overall, the underlying assumption of this study is that MSC is a legitimate and credible organization that has the ability to promote wild fisheries being conducted in a sustainable manner. As such, the overarching hypothesis of this study is that the MSC program can complement the bycatch mitigation already taking place at the regional and national levels in the Canadian Northwest Atlantic longline swordfish fishery. The following chapters therefore address this hypothesis and the aforementioned research questions. Chapter 2 provides a general overview of the Canadian Northwest Atlantic longline swordfish fishery. Chapter 3 moves into the MSC certification process and the certification of this fishery regarding its Principle 2 bycatch conditions and client action plan. Chapter 4 stresses the importance of bycatch mitigation, given its contention in the Canadian Northwest Atlantic longline swordfish fishery. Chapter 5 includes the methodology developed for this study, specifically the FAO/SMART table analysis. Chapter 6 presents the results from the case study analysis. Chapter 7 discusses the results to provide recommendations for moving forward. Finally, Chapter 8 states the major findings of this study and the opportunities for future directions.

CHAPTER 2: THE CANADIAN NORTHWEST ATLANTIC LONGLINE SWORDFISH FISHERY

The Northwest Atlantic Canada swordfish fishery began commercially in the late 1880s, entirely composed of harpoon sailing vessels (DFO, 2009). Because this harpoon fleet required calm and clear weather to detect individual swordfish visually, it was most active during the months of July and August (Stone & Dixon, 2001). In 1962, longline gear was pioneered, consequentially resulting in a shift from the harpoon sailing fleet to a longline fleet (Caddy, 1976). This shift was attributed to the longline fleet's ability to increase daily catches and enable fishermen to operate in weather conditions that were once unfavorable for harpooning (Caddy, 1976; DFO, 2009). As a result, this fishery extended both in season and geographic range, significantly increasing annual catches (Stone & Dixon, 2001). In the 1960's, there were virtually no rules or regulations under a fishery management system, such as having minimum size limits. By 1970, the fishery began to experience sharp declines in landings (DFO, 2009).

In 1971, the U.S. Food and Drug Administration (FDA) discovered mercury levels higher than the acceptable level of 0.5ppm in swordfish meat (Lipton, 1986). As a result, the US and Canadian swordfish markets were closed for eight years, essentially shutting down both the US and Canadian swordfish fisheries (Fitzgerald, 2000; Stone & Dixon, 2001). In 1979, a National Marine Fisheries Service (NMFS) study showed that mercury levels of 1.0ppm were not significant enough to compromise consumer health. Therefore, the FDA increased their acceptable mercury levels to 1.0ppm, enabling the rebound of the US and Canadian swordfish fisheries by 1980 (Stone & Dixon, 2001).

Despite the inactivity in the Canadian swordfish fishery due to high levels of mercury, post-1980 stock assessments continued to show declines in swordfish stocks. In response, the

International Commission on the Conservation of Atlantic Tunas (ICCAT[1]) implemented the first measures for swordfish conservation in 1991 (ICCAT, 1991). These measures included (i) a reduction in catch by 15% from 1988 levels, and (ii) an implementation of minimum size requirements (DFO, 2009; ICCAT, 1991). However, the North Atlantic swordfish stock was still shown to have declined by 68% since 1968 (Fiztgerald, 2000). As such, in 1999, conjoined efforts between Canada and ICCAT resulted in a 10-year recovery plan for the Northwest Atlantic swordfish. Subsequent national plans and policies were put into place by the Department of Fisheries and Oceans (DFO) to supplement this plan and ensure its success. Some of these included: Canada's Swordfish Plan (2000-2002), Individual Transferable Quotas (2003), and the Canadian Atlantic Swordfish and Other Tunas Integrated Fisheries Management Plan (2004-2006). Scientific assessments eventually began to show that the Northwest Atlantic swordfish stock was fully rebuilt (DFO, 2013a). As a result, following a decade of declining quotas, ICCAT was able to increase catches for 2003. The quota for 2013 is currently at 3,559.2 tonnes, which is shared amongst all ICCAT Contracting Parties[2].

The current Canadian Northwest Atlantic longline swordfish fishery extends from George's Bank, South of Nova Scotia, to the Flemish Cap, East of Newfoundland, (Figure 2) from May to November (ICCAT, 2010; Stone & Dixon, 2001). Currently, the harpoon fleet is allocated 10% of the Canadian swordfish quota, while the longline fleet is allocated 90% of this quota (ICCAT, 2010). This past decade, the Northwest Atlantic Canada swordfish fishery

[1] ICCAT is a regional fisheries management organization (RFMO) formed in 1969 to conserve tuna and tuna-like species in the Atlantic Ocean and adjacent seas (ICCAT, 2007).

[2] US, Japan, South Africa, Ghana, Canada, France, Brasil, Maroc, Korea, Côte D'Ivoire, Angola, Russia Gabon, Cap-Vert, Uruguay, São Tomé E Principe, Venezuela, Guinea Ecuatorial, Guinee Rep, United Kingdom, Libya, China, Croatia, European Union, Tunisie, Panama, Trinidad & Tobago, Namibia, Barbados, Honduras, Algérie, Mexico, Vanuatu, Iceland, Turkey, Philippines, Norway, Nicaragua, Guatemala, Senegal, Belize, Syria, St Vincent & The Grenadines, Nigeria, Egypt, Albania, Sierra Leone, Mauritania

averaged landings from 1,200 to 1,300 tonnes, exporting approximately 90% of these landings to US markets (DFO, 2013a).

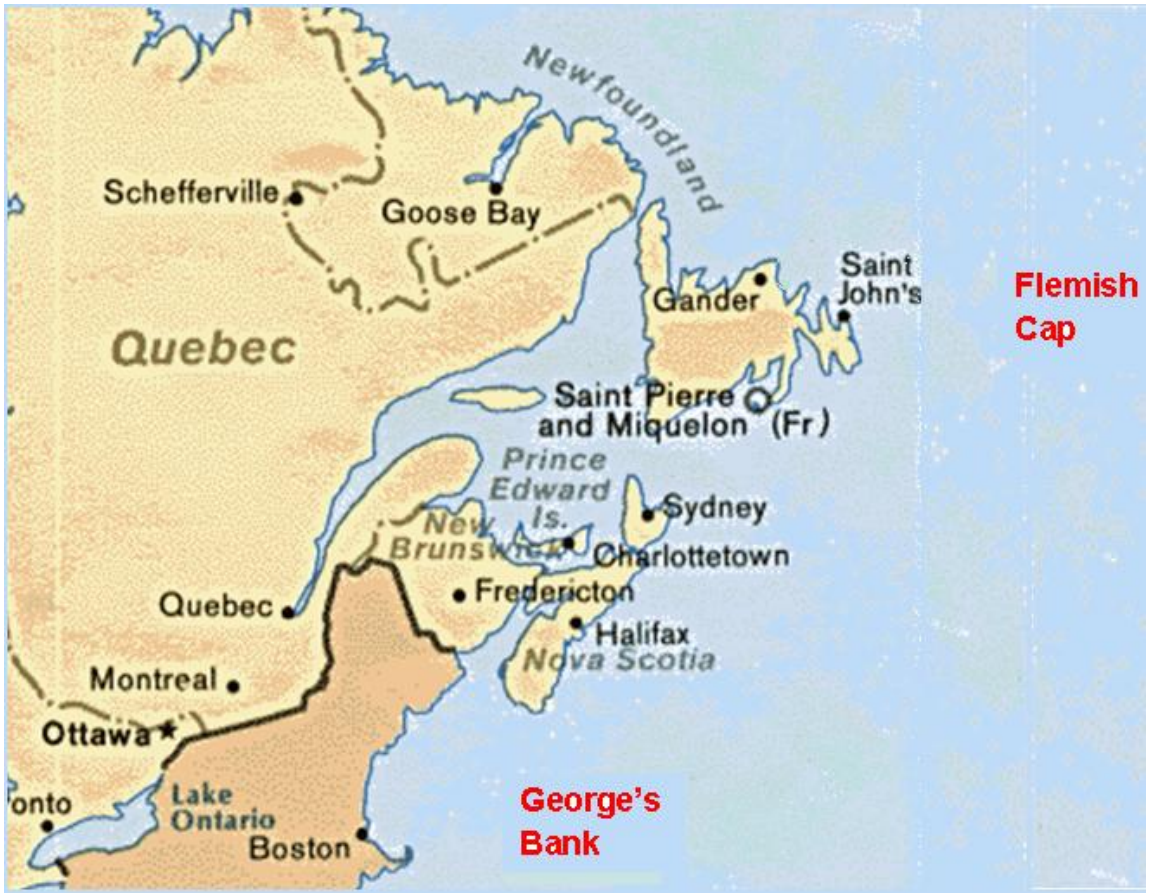


Figure 2. Map depicting the location of George's Bank and the Flemish Cap, which delineate the Canadian Northwest Atlantic longline swordfish fish fishery (map adapted from NationMaster, 2013).

2.1 Harpoon Fleet

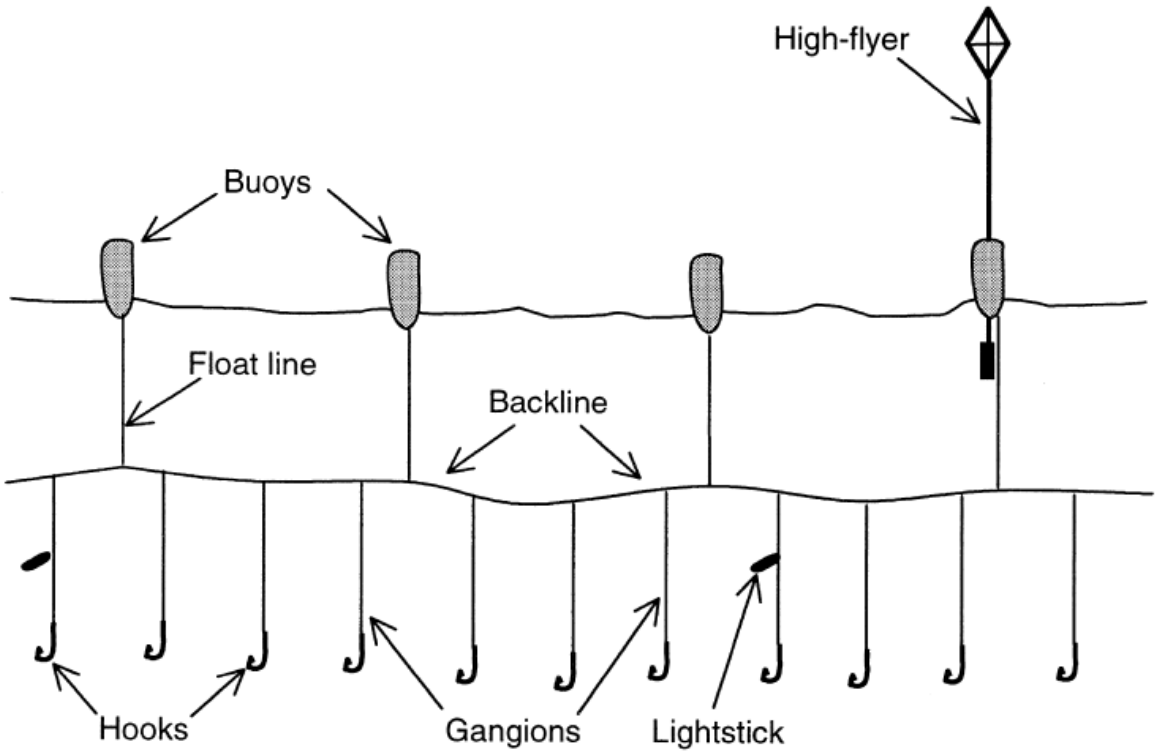
Nova Scotia harpoon fishermen, represented by the Swordfish Harpoon Association and SHQ Harpoon Quota Society, sought MSC certification to assist consumers in differentiating between harpoon-caught and longline-caught swordfish. According to Fuller *et al.* (2008), harpoons are the least damaging fishing gear used in the North Atlantic swordfish fishery, having

no bycatch or impact on habitat. Harpooning involves the spearing of individual swordfish, typically basking or finning at the water's surface, with a long harpoon attached to a buoy or floating drum, which is then connected to a line to haul catch onboard (Fuller *et al.*, 2008). This fleet consists of 1,242 harpoon-only licenses in Atlantic Canada, however, according to DFO records, only 188 have been found to be recently active (DFO, 2009). Given that this harpoon fleet has little to no bycatch, there were no concerns regarding bycatch. As a result, this contributed largely to its MSC-certification by Intertek Moody Marine (IMM) in June 2010 (IMM, 2010). Harpoon fishermen sought MSC certification as their initial strategy to receive a larger share of Canadian swordfish quota through market forces (Rigney, 2008), however, the longline fleet also sought MSC certification and were successful in this regard two years later.

2.2 Longline Fleet

In April 2012, the Northwest longline swordfish fishery was certified under MSC by IMM. As such, there are now two Units of Certification (UoC) within the Atlantic Canada swordfish fishery: the harpoon fleet and longline fleet. However, the certification of the longline fishery spurred much controversy, particularly around its bycatch. Each longline extends up to 30-50 miles (48-80 km) and has between 600 and 1,100 hooks (IMM, 2011a; Figure 3). On average, the annual targeted catch of 20,000 individual swordfish leads to the bycatch of 100,000 sharks (Christian *et al.*, 2013), 1,200 loggerhead turtles (COSEWIC, 2010), and 170 leatherback turtles (COSEWIC, 2001), illustrating that shark bycatch can exceed the targeted catch significantly (up to 400%, B. Saier, personal communication, July 29, 2013; Fitzgerald, 2000). In addition, according to Christian *et al.* (2013), these bycatch species can be endangered or threatened species, such as the porbeagle shark (*Lamna nasus*; IUCN Red List status:

endangered), and leatherback sea turtle (*Dermochelys coriacea*; Canada's Species At Risk Act, SARA: endangered).



Legend

Buoy: attached to mark mainline location

Float line: connects buoys to backline

Backline: connects float lines to gangions

Hooks: used (with bait) to catch swordfish

Gangions: connects hooks to backline

Lightstick: intermittently attached to gangions to attract swordfish or their prey

High flyer: attached to both ends for visual reference and gear retrieval

Figure 3. A schematic diagram of a typical Canadian pelagic longline gear configuration (adapted from Stone & Dixon, 2001).

There are 77 longline swordfish license holders, represented by the Nova Scotia' Swordfishermen's Association (NSSA). However, according to DFO records, only 40 licenses have been recently found active (IMM, 2011a; DFO, 2009). Although the longline fishery had observer coverage of 15% in 2001 and 19% in 2002, there is currently observer coverage of ~5-10%, with a minimum of 10% trip coverage during high intensity fishing (Hanke, Andrushchenk, & Croft, 2012). As such, sometimes estimates of bycatch may only be based on a few observations, and therefore remain relatively unknown (Christian *et al.*, 2013; IMM, 2011a). In addition, there are uncertainties of bycatch mortality rates following the discarding of species alive or injured, creating further criticism of this certification. Therefore, adding or revising mandatory bycatch requirements under NSSA's MSC certification may provide an opportunity for its longline fishery to become more sustainable.

CHAPTER 3: AN OVERVIEW OF THE MSC PRINCIPLE 2 ASSESSMENT

A general overview of the assessment structure of the MSC certification program, focusing on Principle 2, is illustrated in Figure 4. Most broadly, the MSC standard contains the three main MSC principles. Because the focus of this study is on bycatch, Principle 2 is broken down in this figure, including retained species, bycatch species, ETP species, habitats, and ecosystems. Recall, this study only examined retained species, bycatch species and ETP species, though it should be noted that habitats and ecosystems are also components within Principle 2. Each component is then evaluated using three performance indicators (PIs): Outcome Status, Management Strategy, and Information/Monitoring. Finally, several scoring issues are used to ensure that different aspects of the PI are evaluated (Table 1; MSC, 2013b).

In order to assess scoring issues, a numerical value is given using scoring elements (e.g. species). This grading system uses scoring guideposts (SGs) to generate numerical values: SG60, SG80, and SG100. The scoring begins at SG60, and if a scoring element is given a value below 60 the applicant is automatically ineligible for MSC certification. Provided the scoring elements pass SG60, they are then assessed at SG80. Those that do not meet this SG are given a numerical value $\geq 60 < 80$ (depending on the assessment and information available) and associated conditions that the fishery must meet. The scoring elements that met SG80 are then assessed at SG100 and given a numerical value accordingly. The overall score given for each PI is not cumulative or based on a numerical average of all scoring issues and scoring elements therein. Rather, a qualitative assessment is used to ensure that this number is representative of the lowest scored scoring issue. This may result in the overall score being equal to the lowest score, however, this is not always the case (MSC, 2010).

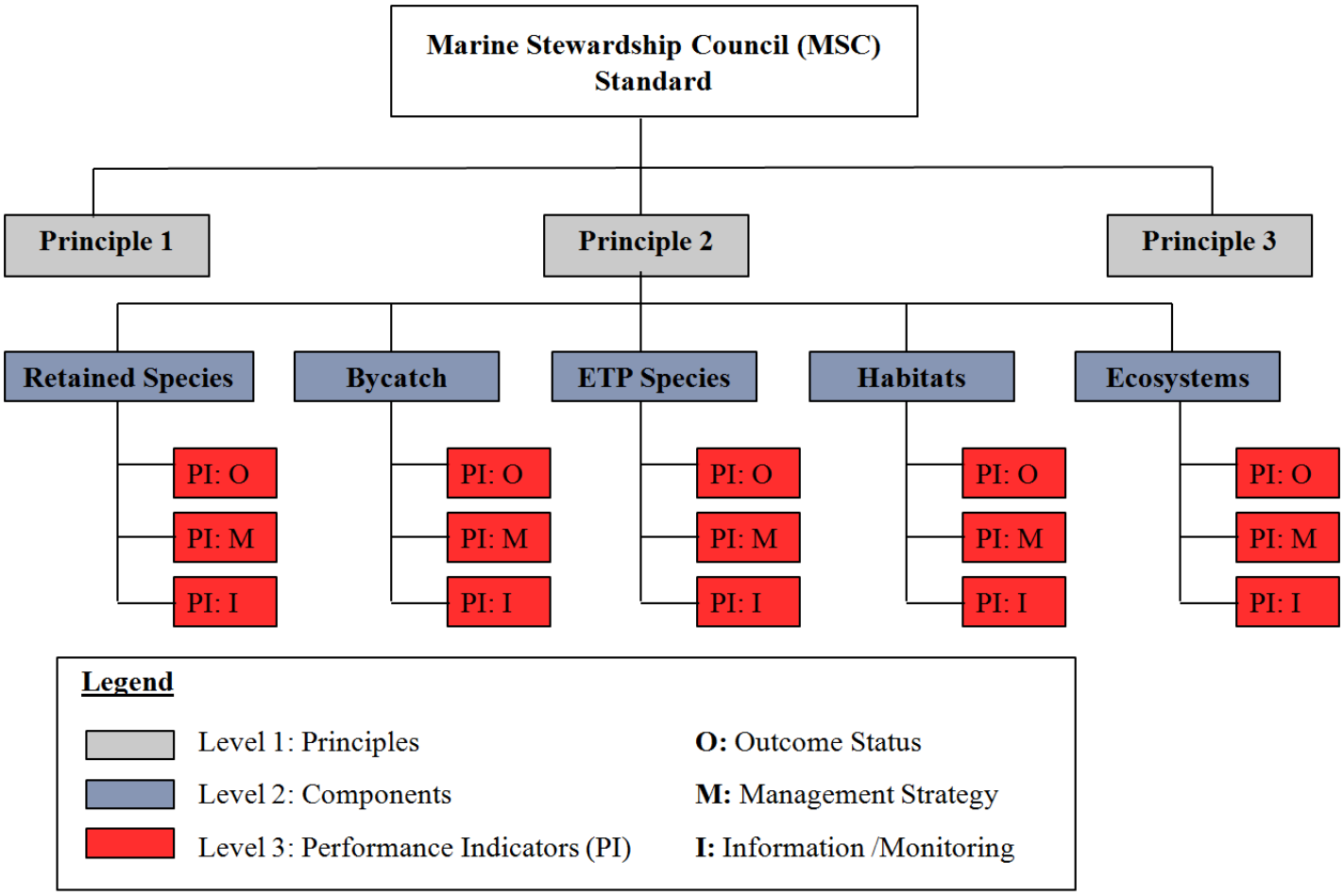


Figure 4. MSC default assessment tree for Principle 2 (adapted from MSC, 2013b).

Component	Performance Indicator	Scoring Issue
2.1 Retained Species	2.1.1 Outcome Status *The fishery does not pose a risk of serious or irreversible harm to the retained species and does not hinder recovery of depleted retained species.*	Retained species stock status
		Target reference points
		Recovery and rebuilding
		Measures if poorly understood
	2.1.2 Management Strategy *There is a strategy in place for managing retained species that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to retained species.*	Management strategy in place
		Management strategy evaluation
		Management strategy implementation
		Management strategy evidence of success
		Shark finning
	2.1.3 Information/Monitoring *Information on the nature and extent of retained species is adequate to determine the risk posed by the fishery and the effectiveness of the strategy to manage retained species.*	Information quality
		Information adequacy for assessment of stocks
		Information adequacy for management strategy
		Monitoring

Component	Performance Indicator	Scoring Issue
2.2 Bycatch Species	2.2.1 Outcome Status *The fishery does not pose a risk of serious or irreversible harm to the bycatch species or species groups and does not hinder recovery of depleted bycatch species or species groups.*	Bycatch species stock status
		Recovery and rebuilding
		Measures if poorly understood
	2.2.2 Management Strategy *There is a strategy in place for managing bycatch that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to bycatch populations.*	Management strategy in place
		Management strategy evaluation
		Management strategy implementation
		Management strategy evidence of success
	2.2.3 Information/Monitoring *Information on the nature and amount of bycatch is adequate to determine the risk posed by the fishery and the effectiveness of the strategy to manage bycatch.*	Information quality
		Information adequacy for assessment of stocks
		Information adequacy for management strategy
		Monitoring

Component	Performance Indicator	Scoring Issue
2.3 ETP Species	2.3.1 Outcome status *The fishery meets national and international requirements for protection of ETP species.* *The fishery does not pose a risk of serious or irreversible harm to ETP species and does not hinder recovery of ETP species.*	Fishery effects within limits
		Direct effects
		Indirect effects
	2.3.2 Management Strategy *The fishery has in place precautionary management strategies designed to: meeting national and international requirements; ensure the fishery does not pose a risk of serious or irreversible harm to ETP species, ensure the fishery does not hinder recovery of ETP species, and minimize mortality of ETP species.*	Management strategy in place
		Management strategy evaluation
		Management strategy implementation
	2.3.3 Information/Monitoring *Relevant information is collected to support the management of fishery impacts on ETP species, including: information for the development of the management strategy; information to assess the effectiveness of the management strategy; and information to determine the outcome status of ETP species.*	Information quality
		Information adequacy for assessment of impacts
		Information adequacy for management strategy

Table 1. Components, performance indicators, and scoring issues for assessing Principle 2 (MSC, 2013b).

One of the most critical parts of the MSC certification process is stakeholder consultation. MSC recognizes that this is a crucial and invaluable part of the certification program. As such, there are several entry points for stakeholder input (Figure 5). MSC also has a formal objections procedure that opposing organizations can use to challenge the certification of a particular fishery. This procedure then provides a platform for CABs to add or revise conditions, or provide further rationale for their scoring and conditions (MSC, 2010). This is the process that the organizations against the certification of the Canadian Northwest Atlantic longline swordfish fishery used to object to IMM's approval of this fishery's certification (see IMM, 2011c).

3.1 INTERTEK MOODY MARINE LTD.

IMM is a private organization that is accredited to ISO/IEC TS 17021-2:2012 – Requirements for Bodies Providing Audit and Certification of Management Systems (IMM, 2013a). IMM has gained credibility by certifying many small and large scale fisheries under the MSC standard across the world. As such, IMM was contracted by NSSA in 2009 (with a pre-assessment conducted before March 2009) to conduct a third party assessment to certify the Canadian Northwest Atlantic longline swordfish fishery. Figure 5 illustrates the general process that IMM should have followed to certify a fishery under the MSC standard. It should be noted that stakeholder consultation also occurs during the formatting of the expert team. It should also be noted that the formal objections procedure requires a completely independent process, involving a contracted lawyer. The decision then takes the form of remands and several iterations before the ultimate decision is made (A. Payne, personal communication, August 28, 2013). Finally, Figure 6 shows the standard process for prioritizing non-ETP bycatch species in a particular fishery.

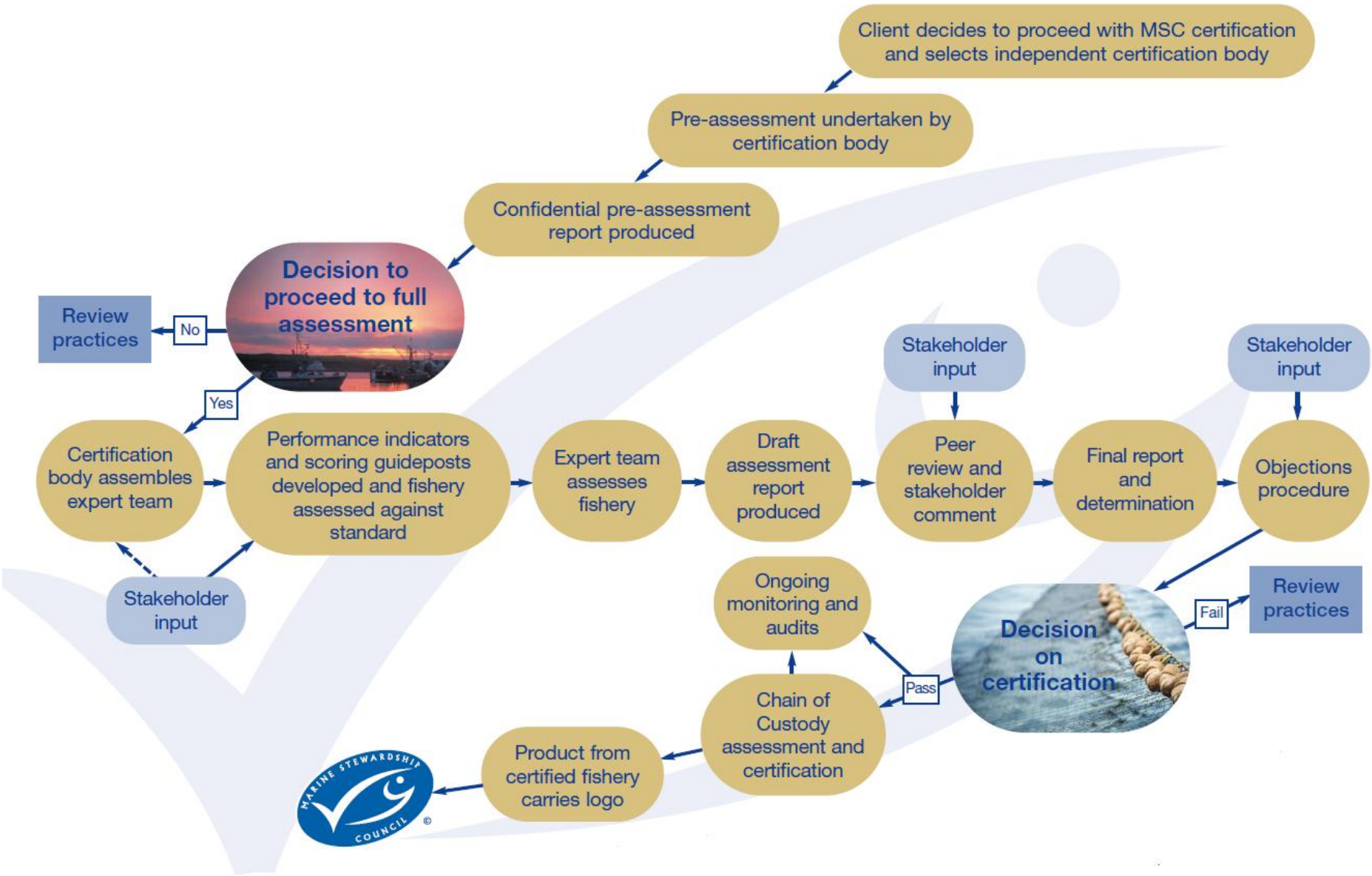
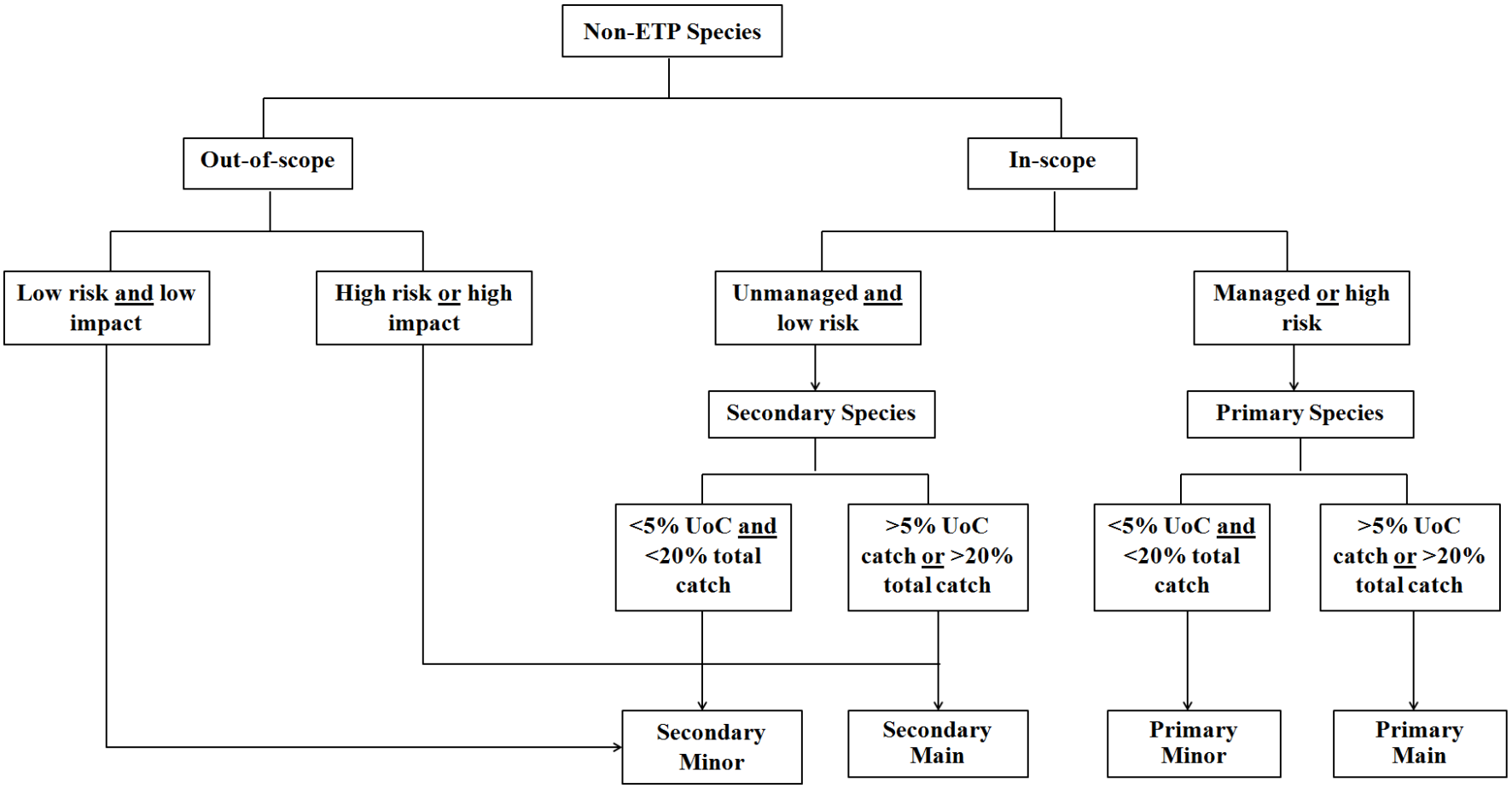


Figure 5. A general decision tree for CABs to assess a fishery under the MSC standard (adapted from MRAG Americas, 2012).



Legend

ETP: Endangered, Threatened, or Protected

UoC: Unit of Certification; includes the target species caught

Total catch: includes all species caught

Out-of scope: species that MSC does not certify (e.g. birds)

In-scope: species that MSC does certify (e.g. tuna)

Figure 6. A decision tree illustrating how CABs designate 'main', 'minor', 'primary', and 'secondary' non-ETP species (adapted from MSC, 2013c).

3.2 Principle 2 Bycatch Conditions and Client Action Plan

The MSC certification of the Canadian Northwest Atlantic longline swordfish fishery took almost four years to become official. This may have been due to the large amount of opposition to this fishery's certification, specifically from environmental organizations. As a result, the peer review and stakeholder consultations demanded several changes be made throughout the MSC certification process. IMM set conditions for the PIs that scored less than 80, including 2.1.1 Retained Species Outcome Status (Score: 75), 2.1.2 Retained Species Management Strategy (Score: 75), 2.2.2 Bycatch Species Management Strategy (Score: 60), 2.3.1 ETP Species Outcome Status (Score: 75), 2.3.2 ETP Species Management Strategy (Score: 75), and 2.3.3 ETP Species Information/Monitoring (Score: 70). IMM originally set three conditions for Principle 2 (Table 2). However, after concerns were raised by multiple stakeholders regarding shark bycatch, IMM issued a total of 6 conditions (relevant to bycatch) in the final report for this fishery. Table 3 includes these final conditions, as well as the client action plan of NSSA.

PI Conditions	**Original Conditions**
2.3.1 Condition	▪ Within four years of certification, the client must demonstrate that direct effects are highly unlikely to create unacceptable impacts to loggerhead turtles ▪ During the first, second and third surveillance audits, the client must provide documented evidence that work is being undertaken which will contribute to attaining the condition requirements by the fourth surveillance audit
2.3.2 Condition	▪ By the first surveillance audit, the client must provide evidence that the Loggerhead Turtle Conservation Action Plan (LCAP) strategy is in place for managing the fishery's impact on ETP species, including measures to minimize mortality, that is designed to be highly likely to achieve national and international requirements for the protection of ETP species.

	▪ By the fourth surveillance audit evidence must be presented to show that the strategy is being implemented successfully. ▪ During the second and third surveillance audit the client must provide documented evidence that work is ongoing that will contribute to the achievement of the fourth year requirements.
2.3.3 Condition	▪ By the fourth surveillance audit, the client must present information considered sufficient to determine whether the fishery poses a threat to protection and recovery of the ETP species, specifically loggerhead turtle. Information must be sufficient to not only measure trends but also support a full strategy to manage impacts. ▪ During each of the first three surveillance audits, the client shall provide documented evidence to demonstrate the steps being taken, and the progress that has been made to achieve the condition requirements by the fourth surveillance audit.

Table 2. The Principle 2 bycatch conditions set in the original public comment draft report (IMM, 2011a).

Final PI Conditions	Client Action Plan
2.1.1 Condition ▪ By the fourth surveillance audit, the client must provide evidence that partial strategies for **shortfin mako** and **porbeagle sharks** have demonstrably effective management measures in place such that the fishery does not hinder their recovery or rebuilding 2.1.2 Condition ▪ By the fourth surveillance audit, the client must provide evidence that there is a partial strategy for conservation of sharks (**porbeagle** and **shortfin mako**) that takes account of all sources of fishing related mortality (landings and discards by the assessed fishery, other Canadian fisheries), and international fisheries. There must be an objective scientific basis to conclude that the strategy will maintain these shark stocks within biological limits or ensure that the fishery does not hinder their recovery and rebuilding. The partial strategy must be in place for the assessed fishery so that, at a minimum, it achieves its proportionate share to conserve sharks.	▪ By second surveillance audit, the client and DFO will outline management strategies and measures for porbeagle sharks in the Canadian Shark Integrated Fisheries Management Plan (IFMP) ▪ Shortfin mako sharks will be managed through a Conservation Action Plan (to be completed by 2013 fishing season) ▪ IFMP and Conservation Action Plan will be reviewed by Atlantic Large Pelagics Advisory Committee (ALPAC) and its sub-committee (Ecosystem Working Group) for stakeholder consultation ▪ DFO will review bycatch methodologies for calculating discards and post-release mortality ▪ Satellite tagging study for shortfin mako sharks began in 2011 to determine post-release mortality; final report will be completed by 2015 ▪ Satellite tagging study for porbeagle sharks will begin in 2013; final report will be completed by 2015 ▪ By second surveillance audit, the client and DFO will demonstrate how post-capture mortalities will be incorporated in future assessments and how they impact rebuilding ▪ DFO will incorporate ICCAT assessments from 2012 and 2014 into management plans ▪ The client and DFO will press for regular ICCAT stock assessments
2.2.2 Condition ▪ By the third surveillance audit, the client must provide	▪ By third surveillance audit, the client and DFO will outline management strategies and measures for blue sharks in the Canadian Shark Conservation Action Plan

evidence that there is a demonstrably effective partial strategy of management measures in place to ensure that the Canadian Atlantic Swordfish fishery does not hinder recovery and rebuilding of the **blue shark** stock. There must be some objective basis of confidence that the partial strategy will work, based on some information directly about the fishery and/or the species involved and there must be some evidence that it is being successfully implemented.	▪ The Canadian Shark Conservation Action Plan will be reviewed by ALPAC and its sub-committee (Ecosystem Working Group) for stakeholder consultation ▪ DFO's bycatch, observer coverage level and observer deployment schemes will be examined in 2011, and the findings will be reviewed by the Ecosystem Working Group
2.3.1Condition ▪ Within four years of certification, the client must demonstrate that direct effects are highly unlikely to create unacceptable impacts to **loggerhead turtles**	▪ The Atlantic Canadian Loggerhead Conservation Action Plan (LCAP) will introduce changes to reduce interaction with and post-release mortality of loggerhead turtles ▪ LCAP performance will be evaluated ▪ Updated information on post-release survival will be provided by DFO Science and the client; final results are expected by 2014 ▪ It is recognized that although gear changes and handling protocols are introduced, these will be difficult to measure their effectiveness (and offset by other factors) ▪ Regional Advisory Process (RAP) was held July 2011 to evaluate observer data precision and provide recommendations ▪ Additional observer training and protocols were implemented by the 2011 fishing season; a data collection and recording system (consistent with the US) will be used to better understand loggerhead turtle life stages ▪ Training and certification program for proper use of safe handling and

	release equipment, and data recording protocols were conducted March 2011; training was mandatory for vessel operators and at-sea observers
2.3.2 Condition ▪ *By the first surveillance audit, the client must provide evidence that the **Loggerhead Turtle** Conservation Action Plan (LCAP) strategy is in place for managing the fishery's impact on ETP species, including measures to minimize mortality, that is designed to be highly likely to achieve national and international requirements for the protection of ETP species.* ▪ *By the fourth surveillance audit evidence must be presented to show that the strategy is being implemented successfully.*	▪ The Atlantic Canadian Loggerhead Turtle Conservation Action Plan (LCAP) was finalized October 2010; measures in the LCAP were included in the 2011 Conditions of License for Swordfish and Other Tunas, the Swordfish Longline Conservation/Harvesting Plan (CHP) and the Swordfish/Other Tuna Integrated Fisheries Management Plan (IFMP); documents will be available for review by first surveillance audit to demonstrate the successful implementation of measures ▪ Regional Advisory Process (RAP) was held July 2011 to evaluate observer data precision and provide recommendations
2.3.3 Condition ▪ *By the fourth surveillance audit, the client must present information considered sufficient to determine whether the fishery poses a threat to protection and recovery of the ETP species, specifically **loggerhead turtle**. Information must be sufficient to not only measure trends but also to support a full strategy to manage impacts.*	▪ The client, through the at-sea observer program and Species At Risk Act (SARA) logbooks, will collect information to assist DFO to determine threats of fishery to loggerhead turtles ▪ Regional Advisory Process (RAP) was held July 2011 to evaluate observer data precision and provide recommendations

Table 3. The final Principle 2 bycatch conditions set and NSSA client action plan (IMM, 2011b). The italicized text represents the same conditions from the original public comment draft report (Table 2), and the bolded text represents the scoring elements.

CHAPTER 4: THE IMPORTANCE OF BYCATCH MITIGATION IN THE CANADIAN NORTHWEST ATLANTIC LONGLINE SWORDFISH FISHERY

Bycatch is among the most significant problems in marine conservation, yet it is poorly documented and largely unmanaged. It is also the leading causes of population declines for some species, such as sharks (Hall *et al.*, 2000; Kelleher, 2005; Lewison *et al.*, 2004). Given that regulations often focus on target commercial species, conservation efforts for bycatch species have assumed a lower priority (Stevens, Bonfil, Dulvy, & Walker, 2000). However, species subjected to bycatch can decline over short timescales without being detected (Lewison *et al.*, 2004). As such, this chapter stresses bycatch as a major concern in the Canadian Northwest Atlantic longline swordfish fishery.

The Canadian Northwest Atlantic longline swordfish fishery has a very high bycatch to target catch ratio, where the bycatch species regularly quantitatively exceed the target species. This may be attributed to the use of non-selective longline gear in pelagic waters, putting marine megafauna that exist in these waters, such as sea turtles, seabirds, marine mammals, and sharks, at a greater risk of being caught (Lewison *et al.*, 2004; Campana, Brading, & Joyce, 2011). In this fishery, the porbeagle shark, blue shark, shortfin mako shark, loggerhead turtle, and leatherback turtle are some of the most vulnerable bycatch species (Table 4).

The objective of the United Nations (1992) Convention on Biological Diversity is to conserve biological diversity, sustainably use its components, and ensure equitable sharing of its benefits. Biological diversity under this international convention is defined as "the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems" (UN, 1992, p. 5). As such, negative impacts

on bycatch species, such as direct impacts through population depletion or indirect impacts through habitat destruction, can lead to a reduction in biological diversity.

Component	**Species**
Bycatch Species *Species that are caught incidentally and not retained*	Blue shark *
	Blackback gull
	Greater shearwater
	Gannet
	Herring gulls
Retained Species *Species that are caught incidentally and retained (usually due to market value)*	Bluefin tuna*
	Bigeye tuna*
	Yellowfin tuna*
	Albacore tuna*
	Mako shark
	Thresher shark
	Porbeagle shark*
	Mahi mahi
	Escolar
	Wahoo
ETP Species *Species that are caught incidentally and listed under binding national and international legislation*	Leatherback turtle
	Loggerhead turtle
	Green sea turtle
	Kempt/Ridley's turtle
	Northern bottlenose whale

Table 4. Bycatch, retained, and ETP species listed in the IMM assessment (IMM, 2011a; MSC, 2013b). The asterisks (*) identify the species that IMM indicated as 'main' species, which are then used as scoring elements.

4.1 SHARKS

Species-specific effects on bycatch species are important to understand to develop appropriate conservation measures. Recent stock assessments for the porbeagle shark, shortfin mako shark, and blue shark show that there is substantial bycatch in the North Atlantic region, particularly from the pelagic longline fisheries (Campana, Brading, & Joyce, 2011). Therefore, the stock status, ETP status, and life history vulnerability of sharks are critical to recognize in the Canadian Northwest Atlantic longline swordfish fishery. Sharks are particularly vulnerable to bycatch because of their life history traits, including slow maturation and low reproductive rates, which can make recovery for these species a challenge (Baum *et al.*, 2003; Fujiwara & Caswell, 2001; Heppell, Crowder, & Menzel, 1999; Lewison & Crowder 2003).

The handling of bycatch species has been shown to influence their post-release mortality. This is an additional threat for sharks, as their post-release mortality rates are largely unknown. Estimated post-release mortality between 1996 and 2010 for sharks in Canadian Atlantic fisheries was around 25-35 metric tonnes annually (Campana *et al.*, 2011). More specifically, according to the satellite tagging study of Campana, Joyce, & Manning (2009), the post-release mortality for blue sharks in the Canadian Northwest Atlantic longline swordfish fishery was approximately 19% between 2001 and 2008. As such, live releases do not necessarily mean the survival of bycatch animals.

Sharks have a range of ecological roles in the marine environment, from key top predators to bottom dwellers and nutrient cycling filter feeders. Therefore, the removal or reduction of sharks can lead to higher-order effects, where the exploitation of a high-order species can have widespread ecosystem impacts through trophic cascades (Lewison *et al.*, 2004). For example, over the past 35 years, 12 to 14 species of shark prey in the Northwest Atlantic

have increased due to shark removal from food webs (Myers, Baum, Shepard, Powers, & Peterson, 2007). In particular, predator removal resulted in an increase in cownose ray populations and subsequent predation on scallops, which terminated a century-long scallop fishery (Myers *et al.*, 2007). Therefore, not only can fisheries directly reduce shark populations, they can indirectly impact other fisheries and vastly alter marine ecosystems.

In the 1990s, markets for shark products, particularly shark fins, began to grow (Clarke, Milner-Gulland & Bjorndal, 2007; Cosandey-Godin & Morgan, 2011). These economic incentives to land sharks that are caught incidentally in fisheries have therefore complicated efforts trying to reduce shark bycatch (Cosandey-Godin & Morgan, 2011). Currently, the Atlantic porbeagle shark population is considered endangered by COSEWIC and vulnerable under the IUCN Red List, the Atlantic blue shark population is considered as a special concern by COSEWIC and near threatened under the IUCN Red List, and the Atlantic shortfin mako shark population is considered threatened by COSEWIC and vulnerable under the IUCN Red List (COSEWIC, 2013; IUCN, 2013).

Stevens *et al.* (2000) noted that shark bycatch could account for 50% of total shark landings, including those from directed shark fisheries. Since 1994, international and national agreements have begun to address market incentives, such as through finning bans, total allowable catch (TAC), and the recent listing of the porbeagle shark under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix II (Campana, Marks, Joyce, & Kohler, 2004; CITES, 2013; PEW, 2013). In contrast, sharks with no market importance are often discarded at sea without being recorded, which can become even more problematic. For example, blue shark bycatch in the Canadian swordfish (and tuna) fisheries accounts for 47-152% of the total catch (DFO, 2002). Given that they are among the

most productive pelagic sharks in the Atlantic, it should be a major concern that their populations have declined by 60% since 1986 (DFO, 2002).

4.2 Sea Turtles

Sea turtles are important to healthy oceans, their ecological roles ranging from maintaining seagrass beds and coral reefs to facilitating nutrient cycling from water to land (Wilson, Miller, Allison, & Magliocca, 2010). Although large declines in sea turtle populations occurred centuries ago, most sea turtle populations are failing to recover due to bycatch in fisheries and marine pollution (e.g. balloons, plastic bags are mistaken for jellyfish; Sea Turtle Conservancy, 2011; Watson, Epperly, Shah, & Foster, 2004). As a result, fisheries need to ensure proper sea turtle bycatch mitigation measures are in place.

The majority of bycatch in the Canadian Northwest Atlantic longline swordfish fishery is sharks, however sea turtles are also caught. In 2006, 13 leatherback turtles and 32 loggerhead turtles were recorded from 17 observer trips, representing 5-10% of the total fishery (Fuller *et al.,* 2008). Although many are currently released alive, their post-release mortality is highly uncertain as many would have experienced physiological injury and/or trauma from interacting with the longline gear (NMFS, 2004a). For instance, sea turtle interactions with longlines typically result in external foul hookings in the front flipper, shoulder, or armpit, causing death upon release (NMFS, 2004a). According to DFO (2010a), the post-hooking mortality rate for the loggerhead turtle in the Canadian Northwest Atlantic longline swordfish fishery is estimated between 20-45%. Furthermore, leatherback turtles have a high post-release mortality rate from longline gear compared to other sea turtles (NMFS, 2004a). Therefore, better estimates of sea turtle post-release mortality rates are still needed to properly mitigate sea turtle bycatch in this fishery.

Currently, the Atlantic loggerhead turtle population is considered endangered by COSEWIC and listed under CITES Appendix I, and the Atlantic leatherback turtle population is considered endangered by COSEWIC and under SARA, and listed under CITES Appendix I (CITES, 2013; COSEWIC, 2013; GoC, 2002). Under CITES requirements, loggerhead turtles and leatherback turtles are not permitted to be retained or landed by the Canadian Northwest Atlantic longline swordfish fishery. Furthermore, Canada currently does not allow international or domestic trade of sea turtle products (IMM, 2013b).

Currently, the bycatch species in the Canadian Northwest Atlantic longline swordfish fishery that have market value are bluefin tuna, bigeye tuna, yellowfin tuna, and albacore tuna. It is also important to note that although there are ETP species considered by IMM (Table 4), they are only those listed under SARA or CITES. MSC only requires the CAB to consider legally binding agreements at the national and international levels to designate ETP species, therefore species listed by COSEWIC and IUCN are only considered as bycatch or retained species. As such, it is important to the conservation of all species that measures are equally as stringent for non-ETP species, given that this potential oversight may lead to unexpected population declines. Overall, indirect ecosystem effects from shark and sea turtle removal from oceanic food webs are still uncertain (Myers *et al.*, 2007). Therefore, the following chapters address the need to develop and implement bycatch mitigation strategies within the Canadian Northwest Atlantic longline swordfish fishery to ensure it is fully sustainable.

CHAPTER 5: METHODOLOGY

To critically assess how the MSC certification of the Canadian Northwest Atlantic longline swordfish fishery could improve its bycatch species conservation and management, a comparative case study analysis was performed. Using seven criteria, the Southeast US North Atlantic longline and handgear buoy line fishery was selected as the most appropriate fishery for comparison. This selection was followed by an analysis of bycatch measures under the MSC certification of both fisheries. The FAO (2011) International Guidelines on Bycatch Management and Reduction of Discards and Doran's (1981) SMART criteria were used to construct an analytical framework for assessing the two fisheries objectively. This chapter provides more detail regarding the case study selection process, and subsequent case review and analysis.

5.1 CASE STUDY SELECTION

To accomplish the objectives of this study, the methodology that was chosen was a comparative case study analysis. The case study selection process began as a consultation with Tonya Wimmer (WWF Species Conservation Manager), Bettina Saier (WWF Director of the Oceans Program), Jarrett Corke (WWF Shark Project Coordinator), and Lucia Fanning (Director of the Marine Affairs Program, Dalhousie University). Through a discussion of the desired goals of this study, a list of potential case studies was produced, primarily consisting of the most contentious MSC-certified fisheries regarding bycatch. However, to ensure this selection process was conducted objectively, a list of criteria was developed. These criteria were used to enable robust comparisons to be made to the MSC certification of the Canadian Northwest Atlantic longline swordfish fishery, minimizing as many confounding factors as possible. Table 5 lists the elements and criteria in the order of importance and subsequent application. For example, criterion 1 was applied before criterion 2, and so on.

Element	Criteria
Certification Standard	**1.** Certification organization must be MSC
Certification Stage	**2.** The client must have received a certificate
Gear Type	**3.** The client must use longline gear
P2 PI Scores	**4.** The client must have scored <80 for at least one P2 PI
Target Species	**5.** The target species must be pelagic
Feasibility	**6.** The client must have undergone at least one surveillance audit
MSC Reference Standards	**7.** A conscious attempt was made to select certifications that used MSC Reference Standards documents that were the same version (or a version that was issued around the same time)

Table 5. Elements and criteria used to select case studies.

Criterion 1 required the certification organization to be MSC, accounting for any variability that might have existed between the fishery certification programmes and eco-labels of similar organizations. Criterion 2 required that the fishery had completed the certification process and received a certificate. This excluded fisheries that had withdrawn or were suspended from the program, as well as fisheries currently in assessment. Criterion 3 required that the fishery used longline gear, enabling more direct comparisons and solutions to be made regarding bycatch issues in longline gear. Criterion 4 required the certified fishery to have received a score less than 80 for at least one PI under Principle 2 relevant to bycatch. Scoring elements that are given a score less than 80 are (i) given conditions and (ii) require a client action plan, which were both necessary for this study's analysis.

Criterion 5 required that the target species must be pelagic. This narrowed down the analysis to target and non-target species that exist in pelagic waters. Criterion 6 required that the client must have undergone at least one surveillance audit to ensure that the deliverables under

the client plan are/were feasible. Finally, criterion 7 required a conscious attempt to select fisheries that used MSC Reference Standard documents that were the same version as those used for the certification of the Northwest Atlantic Canadian longline swordfish fishery (or those that were issued around the same time). This would account for changes to MSC certification requirements and guidelines (e.g. language, default assessment tree) that would complicate direct comparisons from one certification to another.

These criteria provided an opportunity to explore cases with similar, but not identical, bycatch issues and identify the responses taken to mitigate these issues. To ensure that the scope and resources of this project were not exceeded, the criteria also ensured that the number and type of case studies were selectively chosen. Criterion 1 narrowed the case studies down to 286, which were the number of fisheries currently in the MSC program. 205 of these 286 were certified fisheries and had received a certificate. Of those 205 certified fisheries, 21 used longline gear, with 14 scoring less than 80 under for at least one PI under Principle 2 (relevant to bycatch). Of those 14 fisheries, only 3 (including the Canadian Northwest Atlantic longline swordfish fishery) were fishing for pelagic species. Finally, criterion 6 and 7 narrowed down the case studies to the Southeast US North Atlantic longline and handgear buoy line fishery. It should be noted that more case studies would have been analyzed had they met these criterion, however only one was able to be used for the comparison to the Canadian Northwest Atlantic longline swordfish fishery.

5.2 Case Study Review

The two fisheries were reviewed using documents from MSC, CABs, and clients. The case study review was a two-step process, including (i) a background review, and (ii) an assessment against the FAO guidelines and SMART criteria. To have a good understanding of

the context surrounding each case, a review of the governance and institutional backdrop, and relevant management measures already in place for the fishery was conducted. These aspects were important to establish, as they changed how the conditions and client action plan in a particular fishery were assessed. For example, if there were already management measures in place that ensured 100% observer coverage, there was no need for observer coverage to be mentioned in the conditions (with the exception of its monitoring, control, and surveillance). In contrast, if there were no existing management measures in place that ensured sufficient observer coverage, the analysis would require observer coverage to be mentioned in the conditions. Overall, the certification process not only examines the sustainability of the fishery itself, but also the adequacy of existing national and local measures.

Once the background was established, the case review proceeded to the assessment against FAO guidelines and SMART criteria. This study developed an FAO/SMART analysis table (see Table 6) to analyze the MSC certification of the two cases: the Canadian Northwest Atlantic longline swordfish fishery and the Southeast US North Atlantic longline and handgear buoy line fishery (see MRAG, 2011 for client action plan). The FAO/SMART table developed for this study uses a check-off system, which highlight areas in need of improvement, as well as areas that are doing well. MSC prohibits CABs from prescribing specific requirements for these plans, however it is the ultimate decision of the CAB to approve these plans. Therefore, although this study directed most of the recommendations to the client NSSA, these should also be considered by IMM.

5.2.1 FAO Guidelines

This study used the FAO (2011) International Guidelines on Bycatch Management and Reduction of Discards to structure the assessment of each case study. These guidelines were

developed to provide guidance on how to mitigate bycatch and discards, emerging from a participatory process with fisheries experts, government fisheries managers, industry, academia, Non-Governmental Organizations (NGOs), and inter-governmental organizations. Although they are non-binding, and therefore voluntary, these international guidelines establish the foundation for fisheries to develop and implement bycatch and discard measures. There are over 65 guidelines in the FAO (2011) document. Therefore, the guidelines chosen for this study were narrowed down to 16 using four broad criteria (Table 6).

Criteria
1. Must relate to the mandate of MSC
2. Must relate to MSC Principle 2
3. Client must have the capacity to follow the guideline
4. Client must be responsible for following the guideline

Table 6. Criteria for selecting FAO guidelines for case study analysis.

Criterion 1 required the guidelines to relate to the mandate of MSC certification. For example, MSC certification does not require the client to consider the FAO guidelines aimed at developing and implementing awareness, communication and capacity building measures. Therefore, these types of guidelines were omitted. Criterion 2 required the guidelines to relate to MSC Principle 2. More specifically, a conscious effort was made to avoid overlaps with MSC Principle 3, which focuses on the broader management regimes and objectives in a fishery (sometimes relating to bycatch mitigation). For example, the selection process focused on guidelines for bycatch measures, while guidelines for improving the management structure of NSSA, DFO, or ICCAT were omitted. Criterion 3 required the client to have the capacity to

follow the guideline. For example, although the client may request changes to national legislation, it is not in their capacity to make these changes. Therefore the guidelines relating to this aspect were omitted. Finally, criterion 4 required that the guidelines chosen should be the responsibility of the client. For example, the guidelines that referred to changes in State governance frameworks were omitted. These criteria resulted in the selection of 16 FAO guidelines (Column 3 of Table 10).

5.2.2 SMART CRITERIA

The SMART criteria were originally proposed by Doran (1981) to be applied in the development of management targets. SMART is an acronym for Specific, Measurable, Assignable, Realistic, and Time-related. The SMART criteria has been applied across many different subject areas, including NGO project design (Gawler, 2005), policy planning (HM Treasury, 2003), 'greening' government operations (DFO, 2013b), healthcare (Busse & Wismar, 2002; van Herten & Gunning-Schepers, 2000), financial management (Kawohl, Temple-Bird, Lenel, & Kaur, 2003), education (Muncey & McGuinty, 1998), climate data management (Plummer *et al.*, 2007), global plant conservation (Jackson, 2002), Millennium Development Goals (Roberts, 2005), marine protected areas (MPAs; Benzaken, Miller-Taei, & Wood, 2007), and global marine protection (Wood, 2011).

Within the SMART criteria, specific goals indicate a target area in need of improvement. Measurable goals are quantitatively assessed or include an alternative indicator to assess success. Assignable goals specify who is responsible. Realistic goals include tangible results, which can be achieved through the recognition of available resources. Finally, time-related goals include a timeline or deadline for results to occur. According to Doran (1981), "the establishment of objectives and the development of their respective action plans are the most critical steps in a

company's management process" (p. 1). These criteria within the SMART approach serve as a good platform from which to comparatively assess the Northwest Atlantic Canadian longline swordfish fishery.

5.2.3 FAO/SMART TABLE

This study developed an FAO/SMART table to analyze the MSC certification of the Canadian Northwest Atlantic longline swordfish fishery and the Southeast US North Atlantic longline and handgear buoy line fishery. The 16 FAO guidelines and the SMART criteria were used as success indicators to assess bycatch mitigation under each fishery's certification. The success indicators were not selected to provide an overall score for each case study. Rather, the main objective was to draw attention to the areas doing well, and, particularly, the areas in need of improvement. Table 7 illustrates how a check-off system was used to identify these areas. More specifically, the SMART criteria (see Section 5.2.2 for definitions) were applied to each of the 16 FAO guidelines, which are further explained in the following sections (see FAO, 2011 for more detail).

5.2.3.1 MANAGEMENT FRAMEWORK

The management framework is critical in moving towards well managed fisheries, especially regarding bycatch management. As such, planning is an important part of the management framework, offering plans and strategies within the international, regional, national, and/or local context. More specifically, how measures are developed within these plans or strategies are important to assess, given that measures based on poor data will result in a waste of time and resources. Therefore, establishing a robust management framework will provide the operational foundation for improving bycatch mitigation. Table 7 provides an explanation of how the success indicators were used to assess each fishery under planning and measures.

Planning	*Review of existing initiatives:* included the identification of (i) international, regional, national, and/or local plans, (ii) what aspects of these plans would be reviewed (if any), and (iii) how these plans would be reviewed.
	Review and/or development of alternative methods: included the identification of (i) pursuing alternative plans or strategies (e.g. consolidating single species plans, integrating bycatch measures into commercial species plans), and (ii) transitioning to alternative gear type(s).
	Review and/or development of monitoring plans: included the identification of (i) an observer coverage plan, (ii) an at-sea electronic monitoring plan, (iii) VMS monitoring plan, (iv) logbook plan, and (v) an auditing system.
Measures	*Best scientific and technical knowledge:* included the identification of (i) the legitimacy and credibility of sources used, and (ii) the use of multiple sources.
	Stakeholder consultation: included the identification of (i) data publicly available, (ii) sufficient consideration of formal objections (e.g. through changes in conditions or client action plan), and (iii) sufficient consideration of general comments and responses.

Table 7. An explanation of the FAO success indicators under Management Framework.

5.2.3.2 DATA COLLECTION

Data collection, reporting, and assessment provide the foundation for the development of bycatch measures. As such, appropriate and reliable methods should be established to gather good information of what bycatch species are being caught, as well as robust estimates of their catch rates. This also extends to furthering research and development to ensure bycatch management is applying the most up-to-date measures, such as at-sea electronic monitoring.

Table 8 provides an explanation of how the success indicators were used to assess each fishery under methods and research and development.

Methods	*Dockside monitoring:* included the identification of the level of dockside monitoring.
	Effective observer coverage: included the identification of (i) the level of observer coverage, and (ii) the quality of observer coverage (e.g. accuracy of species identification).
	Mandatory reporting: included the identification of (i) mandatory logbook recording, and (ii) which species required mandatory reporting.
Research and Development	*Use of standardized training programs/workshops:* included the identification of (i) training programs/workshops (e.g. best handle and release practices for bycatch species), and (ii) mandatory workshop attendance.
	Collaboration with other institutions: included the identification of (i) pilot projects with research institutions (e.g. university departments), and (ii) reasonable delegation of action to institutions other than the client (i.e. the client should be responsible for the majority of the deliverables under their client action plan).

Table 8. An explanation of the FAO success indicators under Data Collection.

5.2.3.3 Fishing Gear and Bycatch Mitigation Devices

Fishing gear and bycatch mitigation devices are critical to ensure bycatch species are not being caught, or, if they are, to ensure they survive. These include, but are not limited to, input and/or output controls, the improvement of the design and fishing gear, and spatial and temporal measures. Other mitigation strategies were also included, which can range from de-hooking

equipment to remote sensing technology. Table 9 provides an explanation of how the success indicators were used to assess each fishery under gear and other mitigation strategies.

Gear	*Changes in design, rigging, or deployment*: included the identification of (i) gear changes (e.g. circle hooks vs. J hooks), (ii) submerged time limits, (iii) hook depth, (iv) minimum gangion lengths, and other measures specific to the fishery's bycatch species.
	Bycatch reduction devices: included the identification of (i) deterrents, (ii) lightsticks, which attract swordfish or their prey, (iii) alternative bait, and other measures specific to the fishery's bycatch species (e.g. tori lines for sea birds).
Other Mitigation Strategies	*Equipment for improved post-capture release survival*: included the identification of de-hooking equipment and other measures specific to the fishery's bycatch species (e.g. shark ventilation equipment).
	Measures mitigating pre-catch losses and ghost fishing: included the identification of (i) the recognition of ghost fishing, and (ii) measures to address ghost fishing (if applicable). *Remote sensing technology and/or modeling*: included the identification of (i) the use of VMS, (ii) at-sea electronic monitoring (e.g. closed circuit television, CCTV), and (iii) satellite tagging studies to estimate post-release mortality.
	Operational avoidance techniques: included the identification of time (e.g. seasonal) or area closures to protect bycatch species.

Table 9. An explanation of the FAO success indicators under Fishing Gear and Bycatch Mitigation Devices.

Table 10. FAO/SMART analysis table.

FAO International Guidelines on Bycatch Management and Reduction of Discards			**S**	**M**	**A**	**R**	**T**
Management Framework	Planning	Review of existing initiatives					
		Review and/or development of alternative methods					
		Review and/or development of monitoring plans					
	Measures	Best scientific and technical knowledge					
		Stakeholder consultation					
Data Collection	Methods	Dockside monitoring					
		Effective observer coverage					
		Mandatory reporting					
	Research and Development	Appropriate monitoring/evaluation techniques					
		Use of standardized training programs/workshops					
		Collaboration with other institutions					
Fishing Gear and Bycatch Mitigation Devices	Gear	Changes in design, rigging, or deployment					
		Bycatch reduction devices					
	Other Mitigation Strategies	Equipment for improved post-capture release survival					
		Measures mitigating pre-catch losses and ghost fishing					
		Remote sensing technology and/or modeling					
		Operational avoidance techniques					

✓ = Yes **◆ = Partially** **✕ = No** **✓ or ◆ = Already in place (prior to certification)**

CHAPTER 6: CASE STUDY RESULTS

This chapter includes (i) a case study review of the Canadian Northwest Atlantic longline swordfish fishery and the Southeast US North Atlantic longline and handgear buoy line fishery, and (ii) subsequent case analysis. These results are then further discussed in Chapter 7 to provide recommendations for the Canadian Northwest Atlantic longline swordfish fishery moving forward.

6.1 CASE STUDY REVIEW

The case study review required an examination of the governance and institutional backdrop, and management measures relevant to bycatch that were in place prior to MSC certification. As such, eight categories of background information were included (Column 1 of Table 10). International bodies and agreements were required to identify international expectations, such as 5% observer coverage in all fisheries under the ICCAT mandate. The main national body was required to identify the governmental department with the authority to develop, change, or implement national legislation relevant to bycatch in fisheries. The national legislation was required to identify what species were designated as ETP species at the national level, and subsequently designated by IMM. National and regional plans were required to identify the existing management strategies and/or plans in place to mitigate bycatch in fisheries. Finally, fishery-specific details were identified, including observer coverage, dockside monitoring, and license conditions. It was important to establish this background information to appropriately analyze each fishery's MSC certification. For instance, requiring the use of a SARA logbook under the MSC certification of the Canadian Northwest Atlantic longline swordfish fishery would not be necessary, as it was already a requirement in this fishery prior to certification. Table 11 provides a synopsis of the background information collected for the Canadian Northwest Atlantic longline swordfish fishery and the Southeast US North Atlantic longline swordfish fishery.

Existing Management	Canadian Northwest Atlantic Swordfish	Southeast US North Atlantic Swordfish
International Bodies and Agreements	▪ Both parties to CITES ▪ Both members of ICCAT - 5% observer coverage - 5% ratio fins to carcasses	
National Body	Canada Department of Fisheries and Oceans (DFO) – Atlantic Region	US National Marine Fisheries Service (NMFS)
National Legislation	Species At Risk Act (SARA)	Endangered Species Act (ESA)
National and Regional Plans	▪ Shark Integrated Fisheries Management Plan (IFMP) ▪ Shark Conservation Action Plan (CAP) ▪ Loggerhead Conservation Action Plan (CAP) ▪ Canada's National Plan of Action for the Conservation and Management of Sharks (NPOA-Sharks)	▪ Final Consolidated Highly Migratory Species Fisheries Management Plan (FMP)
Observer Coverage	Minimum 5%	8%
Dockside Monitoring	100%	100%
Closures	Zone 1 of Gully MPA	Time-area closures (see NMFS, 2006)
License Conditions	▪ SARA Logbook ▪ Voluntary sea turtle Code of Conduct - Circle hooks - De-hooking equipment - Monofilament line - No wire leaders ▪ Vessel Monitoring System (VMS)	▪ Fishery logbook system (FLS) ▪ Vessel Monitoring System (VMS) ▪ Large circle hooks with offsets ▪ Min. gangion lengths ▪ De-hooking equipment ▪ Workshop attendance (e.g. Protected Species Safe Handling, Release, and Identification workshop, held every 3 years)

Table 11. Relevant background information regarding bycatch mitigation prior to the MSC certification of the Canadian Northwest Atlantic longline swordfish fishery and the Southeast US North Atlantic longline swordfish fishery.

6.2 Case Study Analysis

The FAO/SMART table was used to analyze the Canadian Northwest Atlantic longline swordfish fishery (Table 12) and the Southeast US North Atlantic longline swordfish fishery (Table 13) regarding bycatch mitigation under their MSC certification. The check off system was used to identify areas of the Canadian Northwest Atlantic longline swordfish fishery that can be improved, as well as areas of this fishery doing well. This system was also used to identify which areas in the Southeast US North Atlantic longline swordfish fishery can be used to improve those that are lacking in the Canadian fishery. For example, 'effective observer coverage' in the US fishery was specific, measurable, assignable, realistic and time-related, while the Canadian fishery's 'effective observer coverage' was lacking in its realistic and time-related components (see Section 7.2). As a result, the US fishery was used to address these lacking components. Chapter 7 further discusses these results from Tables 12 and 13 to develop recommendations for the Canadian Northwest Atlantic longline swordfish fishery moving forward.

Table 12. FAO/SMART analysis of the Canadian Northwest Atlantic longline swordfish fishery

FAO International Guidelines on Bycatch Management and Reduction of Discards			**S**	**M**	**A**	**R**	**T**
Management Framework	Planning	Review of existing initiatives	✓	✓	✓	✕	✓
		Review and/or development of alternative methods	✕	✓	✓	✕	✓
		Review and/or development of monitoring plans	✕	✓	✓	✕	✓
	Measures	Best scientific and technical knowledge	✓	✓	✓	◆	✓
		Stakeholder consultation	✓	✓	✓	◆	✓
Data Collection	Methods	Dockside monitoring	✓	✓	✓	✓	✓
		Effective observer coverage	✓	✓	✓	✕	✕
		Mandatory reporting	✕	✕	✓	✕	✕
		Use of standardized training programs/workshop	✓	✓	✓	✕	✓
		Collaboration with other institutions	◆	✕	✓	◆	✓
Fishing Gear and Bycatch Mitigation Devices	Gear	Changes in design, rigging, or deployment	◆	◆	◆	◆	◆
		Bycatch reduction devices	✕	✕	✕	✕	✕
	Other Mitigation Strategies	Equipment for improved post-capture release survival	✓	✓	✓	◆	✓
		Measures mitigating pre-catch losses and ghost fishing	✕	✕	✕	✕	✕
		Remote sensing technology and/or modeling	✓	✓	✓	◆	✓
		Operational avoidance techniques	◆	◆	◆	◆	◆

✓ = Yes **◆ = Partially** **✕ = No** **✓ or ◆ = Already in place (prior to certification)**

Table 13. FAO/SMART analysis of the Southeast US North Atlantic longline swordfish fishery

FAO International Guidelines on Bycatch Management and Reduction of Discards			**S**	**M**	**A**	**R**	**T**
Management Framework	Planning	Review of existing initiatives	✓	✓	✓	✓	◆
		Review and/or development of alternative methods	✓	✓	✓	✓	✓
		Review and/or development of monitoring plans	✕	✓	✓	◆	✓
	Measures	Best scientific and technical knowledge	✓	✓	✓	◆	✓
		Stakeholder consultation	✓	✓	✓	✓	✓
Data Collection	Methods	Dockside monitoring	✓	✓	✓	✓	✓
		Effective observer coverage	✓	✓	✓	✓	✓
		Mandatory reporting	✓	✓	✓	◆	✓
		Use of standardized training programs/workshop	✓	✓	✓	✓	✓
		Collaboration with other institutions	✓	✓	✓	✓	✓
Fishing Gear and Bycatch Mitigation Devices	Gear	Changes in design, rigging, or deployment	✓	✓	✓	✓	✓
		Bycatch reduction devices	✕	✕	✕	✕	✕
	Other Mitigation Strategies	Equipment for improved post-capture release survival	✓	✓	✓	◆	✓
		Measures mitigating pre-catch losses and ghost fishing	✕	✕	✕	✕	✕
		Remote sensing technology and/or modeling	✓	✓	✓	◆	◆
		Operational avoidance techniques	✓	✓	✓	✓	✓

✓ = Yes **◆ = Partially** **✕ = No** **✓ or ◆ = Already in place (prior to certification)**

CHAPTER 7: DISCUSSION AND RECOMMENDATIONS FOR THE CANADIAN NORTHWEST ATLANTIC LONGLINE SWORDFISH FISHERY

Drawing on the results from the comparative analysis of the two fisheries, this chapter uses the three categories from the FAO/SMART table analysis: (i) management framework, (ii) data collection, and (iii) fishing gear and bycatch mitigation devices (Column 1 of Table 10) to discuss areas for improvement regarding bycatch in the Canadian Northwest Atlantic longline swordfish fishery.

7.1 MANAGEMENT FRAMEWORK

The NSSA's longline swordfish fishery's MSC certification builds off national-level initiatives that are being developed and implemented by DFO. These include the Canadian Shark Integrated Fisheries Management Plan (IFMP) and the Shark Conservation Action Plan (CAP), under Canada's National Plan of Action for the Conservation and Management of Sharks (NPOA-Sharks; see DFO, 2007 for plan). These plans fulfill the PI 2.1.1 and 2.1.2 condition requirements for a partial strategy, defined as "a cohesive arrangement comprising of one or more measures[3], but not having necessarily been designed explicitly for that component" (MSC, 2010, p. 44). These national and regional plans are currently being explicitly developed for the components: porbeagle shark and shortfin mako shark, and therefore meet the strategy requirement for this condition.

The client action plan for the PI 2.1.1 and 2.1.2 conditions, with regards to these national plans, include (i) an outline of management strategies and measures for porbeagle sharks in the IFMP, (ii) the completion of the CAP by the 2013 fishing season, and (iii) a review of the IFMP

[3] Measures are defined as "individual actions or tools to manage direct and/or direct impacts on the component" (MSC, 2010, p. 44).

and CAP by Atlantic Large Pelagics Advisory Committee (ALPAC) and their Ecosystem Working Group. These deliverables are assignable and have been delegated accordingly. However, NSSA did not consult all members of the ALPAC or the Ecosystem Working Group regarding the responsibilities they would have under this condition (IMM, 2011c). Consequently, in the first surveillance audit report, IMM noted that the Ecosystem Working Group has actually been inactive for the past 2 years, and therefore will not review these plans. This illustrates inappropriate planning with regards to reviewing existing initiatives, and represents IMM's oversight when approving NSSA's client action plan.

The NSSA's longline swordfish fishery's MSC certification builds off DFO's Atlantic Canadian Loggerhead turtle Conservation Action Plan (LCAP) for the protection of loggerhead turtles (see DFO, 2011 for plan). Under the PI 2.3.2 condition, the client is required to show evidence[4] that the LCAP is (i) developed by the first surveillance audit, and (ii) implemented successfully by the fourth surveillance audit. The first surveillance audit report indicated progress had been made against a number of LCAP projects by DFO Resource Management. However, the client action plan was still determined to be on track (IMM, 2013b). In addition, IMM noted that the existing LCAP reviewed during the first surveillance audit was essentially the DFO work plan (see DFO, 2010b). Not only does NSSA heavily rely on DFO to carry out this deliverable, they also have very little control in ensuring that this work plan is followed on a timely basis and in accordance with their certification conditions. Overall, IMM should recognize that the cooperation with DFO to develop and implement this plan should not serve as

[4] Objective evidence: verifiable information or records pertaining to the quality of an item or service or to the existence and implementation of a quality system element, which is based on visual observation, measurement or test that can include independent witnesses, peer-reviewed scientific research, or otherwise verifiable and credible information

a rationale to postpone sea turtle bycatch measures in the Canadian Northwest Atlantic longline swordfish fishery.

The NSSA client action plan required the review of bycatch methodologies for calculating discards and post-release mortality to be completed by the first surveillance audit. This review was conducted at a meeting in July 2011 by DFO to be incorporated into future stock assessments of bycatch species, with the porbeagle shark and loggerhead turtle having the highest priorities. Not only did this meeting occur a year prior to the certification of the Canadian Northwest Atlantic longline swordfish fishery, this review was also conducted by DFO. IMM approved this deliverable under the client action plan because it was also a deliverable under the client action plan of the Northwest Atlantic Canada harpoon swordfish fishery (certified two years earlier). As such, this harmonized the deliverables for these two UoCs. However, it was unrealistic to give this deliverable an entire year to be met, given that it already had been completed well before the longline fishery's certification. Furthermore, this was the only deliverable that the NSSA had to present to IMM at the first surveillance audit, and therefore did not have to do anything beyond providing copies of DFO's review.

In contrast, the client action plan of the Day Boat Seafood LLC.'s Southeast US North Atlantic longline and handgear buoy line fishery stated that the client would present a plan for improved data collection for its bycatch species: blue marlin, white marlin, and Atlantic sailfish by the first surveillance audit. The first surveillance audit report identified several aspects of this plan, including mandatory attendance at NMFS Protected Species Safe Handling, Release, and Identification workshops, shark identification placards on-board, mandatory attendance at Florida Logbook Reporting workshops, incremental increases in observer coverage, and an at-sea electronic monitoring system pilot project. Not only does this plan contain more specific and

realistic deliverables to mitigate bycatch, it is also within the capacity of Day Boat Seafood LLC to complete[5].

The review and development of monitoring plans are critical components of fishery management regimes. These dictate the effectiveness of plans and the components therein. For example, it is important to ensure that the data are accurate from observers and logbooks, which have been known to be biased and inaccurate (Rago, Wigley, & Fogarty, 2005). The Day Boat Seafood LLC is involved in an at-sea electronic monitoring pilot project that will be able to ensure the accuracy of observer coverage and/or what level of observer coverage is needed. This pilot project is underway, having installed a camera and provided mobile DVR that has dual SD cards, which are then retrieved and compared with the vessel trip reports. Logbooks will also be audited using this at-sea electronic monitoring program to identify the level of accuracy that this additional data offer.

In contrast, NSSA does not specify any auditing systems to determine the accuracy of the Canadian Northwest Atlantic longline swordfish fishery's observer coverage or logbooks. Inaccurate observer coverage or logbooks is problematic, given that NSSA is required to provide evidence to demonstrate that the management measures they have implemented are effective. As such, without accurate data, NSSA will not be able to provide substantial evidence for mitigating their bycatch. For example, the MSC-certified Denmark North Sea and Skagerrak longline haddock fishery have sought the use of CCTV through a pilot project with the Danish Technical University, National Institute of Aquatic Resources (FCI, 2012). Similarly, the Canada Pacific halibut longline fishery uses an at-sea electronic monitoring program, currently auditing ~10% of

[5] The US government fisheries policy states that the specific commitment of the government to actions supporting any private sector certification program is not allowed (MRAG, 2011)

observer data (SCS, 2009). Therefore, NSSA should be expected to seek pilot projects and research for at-sea electronic monitoring, extending to both CCTV and electronic logbooks for real time information.

In addition to furthering their at-sea electronic monitoring capacity, Day Boat Seafood Ltd. has committed to increasing the observer coverage in their Southeast US North Atlantic longline and handgear buoy line fishery to 20% by the first surveillance audit (which was successfully completed), 40% by the 3rd year, 80% by the 4th year, and 100% by the end of their certification period. Given that this fishery must have 5% observer coverage under ICCAT requirements, and 8% under national requirements (MRAG, 2011), having increased their observer coverage beyond these requirements illustrates the fishery's initiative and capacity, as well as the perceived necessity for this action.

In contrast, although the client action plan of NSSA states that DFO's scientific body (Canadian Science Advisory Secretariat, CSAS) examined observer coverage levels and deployment schemes in 2011, this review did not reach consensus on an optimal level or allocation of observer coverage. However, NSSA should not rely on a single DFO report to determine when or if its observer coverage will increase. For example, a CSAS report that came out in 2012 (Hanke *et al.*, 2012) provided numerous examples of (i) observer coverage in fisheries across the globe, and (ii) several models used to determine appropriate observer levels (see Section 7.2).

In the planning stages, measures should be based on both the best scientific and technical knowledge, and stakeholder input. With regards to the certification of the Canadian Northwest Atlantic longline swordfish fishery, IMM and NSSA heavily rely on the science of ICCAT and

DFO when developing and implementing bycatch mitigation measures. These include DFO's review of bycatch methodologies for calculating discards and post-release mortality (as mentioned earlier), and ICCAT's stock assessment of bycatch species. ICCAT's 2012 stock assessment of the shortfin mako shark identified that the Atlantic population is within biologically-based limits (ICCAT, 2012), and therefore IMM re-scored the shortfin mako shark component at 80, removing it from the PI 2.1.1 and 2.1.2 conditions.

A review of the existing scientific literature suggests that the decision to remove the shortfin mako shark component from the conditions may have been premature, as there have been several studies critiquing the credibility and accuracy of ICCAT assessments and their methods of data collection. For example, the study of Cullis-Suzuki & Pauly (2010) used 26 criteria from the report 'Recommended Best Practices for Regional Fisheries Management Organizations' (see Lodge *et al.,* 2007 for this report) to evaluate the competency of RFMOs. ICCAT received an average score of 57%, where 0% represented the worst possible performance and 100% represented the best (Cullis-Sukuzi & Pauly, 2010). Similarly, Levesque (2010) notes that ICCAT has been very unsuccessful in managing bycatch species, often prioritizing the conservation and use of target species. Therefore, ICCAT stock assessments and subsequent recommendations should be used with caution. More specifically, it would have seemed appropriate for IMM to have considered research from institutions beyond ICCAT prior to removing shortfin mako sharks from the PI 2.1.1 and 2.1.2 conditions. Alternatively, if research beyond ICCAT is not available, these stock assessments can be used in conjunction with observer coverage and at-sea electronic monitoring to verify accuracy of the data. For example, MRAG approved the use of ICCAT stock assessments in the Day Boat Seafood LLC's client action plan, but this client action plan also included a NMFS and Archipelago Marine Research

Ltd. Electronic Monitoring system pilot study, and observer program support from Dr. David Kerstetter and Nova Southeastern University.

Stakeholder consultation is recognized as playing a key role in developing conditions and client action plans. These include formal objections and general comments directed at the CAB. The certification of both NSSA and Day Boat Seafood LLC. integrated comments from NGOs such as Oceana, PEW, Turtle Restoration Network, Ecology Action Centre, and World Wildlife Fund. In response to concerns raised by these environmental organizations, IMM added three conditions regarding shark bycatch in NSSA's Northwest Atlantic Canada swordfish fishery. Similarly, MRAG approved Day Boat Seafood LLC.'s client action plan only after they stated they would increase the observer coverage in their Southeast US Atlantic Canada longline swordfish fishery. Although objections were still outstanding following both certifications, it should be noted that reports were made publicly available and stakeholders were consulted during the process. The extent to which these objections should be integrated into the conditions and client action plans is outside the scope of this study. Future research may be needed to assess the degree to which CABs consider stakeholder comments and responses, and if these considerations are appropriate.

Overall, stakeholder consultation for both fisheries resulted in criticisms towards the use of longline gear. As such, the Day Boat Seafood Ltd. planned to develop price premiums for handgear buoy line fish products, providing market incentives to transition away from longline gear in this fishery. They also intend to increase the benefits of a handgear buoy line permit, hoping to increase the number of handgear buoy line participants in the fishery by 100% by the end of their certification period. It is important to note that the first surveillance audit report identified that the market incentives for handgear buoy line are already being seen, showing the

feasibility of this deliverable within a one-year period. In contrast, NSSA has not sought alternative gear to use in their fishery and it is not expected that they will even explore such alternatives as those proposed for the US fishery. Moving forward, although eliminating longline gear may not be a near-term viability for the Canadian fishery (and is not necessarily encouraged by MSC), there are practical changes, such as in gear design, that should be implemented.

7.2 Data Collection

The methods used for data collection are important to ensure the accuracy of data, which can account for confounding factors, inherent biases, and overall error. These are also critical for the client to pursue to provide evidence that their bycatch mitigation measures are effective. Dockside monitoring, observer coverage, and logbooks are the primary methods of data collection in the Canadian Northwest Atlantic longline swordfish fishery. While both the NSSA and Day Boat Seafood LLC. are subjected to 100% dockside monitoring, there are major differences in observer coverage and logbook recording. For example, the only deliverable under NSSA's client action plan pertinent to observer coverage was the review by DFO in 2011, which did not identify a specific level of observer coverage that should be required in the Canadian Northwest Atlantic longline swordfish fishery. As such, the first surveillance audit report notes that work will be undertaken in the period 2014-2015 to determine this level for each bycatch species, integrating the results from ICCAT's meeting in July 2012 regarding observer coverage. This timeline is not realistic under the certification of NSSA, who should be developing and implementing their own measures to mitigate bycatch in accordance with the precautionary principle.

Currently, the observer coverage in the Canadian Northwest Atlantic longline swordfish fishery is ~5-10%. This recent reduction from 15-20% in 2001-2002, funded by the Environment Canada's Habitat Stewardship Program (HSP), has been pointed to the fact that industry is now 100% responsible for the costs of observer coverage (effective April 2013; Javitech Ltd., 2003). However, the withdrawal of DFO funds from the Canadian Northwest Atlantic longline swordfish fishery observer program does not serve as a rationale for not being able to improve observer coverage. For example, the MSC-certified Canada Pacific Halibut longline fishery currently has 100% observer coverage from Archipelago Marine Research Ltd., costs of which are paid by industry (SCS, 2009).

The scientific advice used for observer coverage in Canadian longline pelagic fisheries applied models that were developed for 20% observer coverage. As a result, the lower percentage of observer coverage since 2003 (~5-10%) had resulted in whole areas and entire fleets being unobserved (Hanke, Andrushchenko & Croft, 2012). Although this has now been addressed, it is important to continue to ensure that the models used for distributing observers are adaptable.

There are also biases that may exist in observer programs, such as the random selection of vessels to observe or the level of compliance in the presence of an observer (Observer Effect; Volstad & Fogarty, 2006; Benoît & Allard, 2009), which can be difficult to account for post-hoc. Furthermore, observer quality has not necessarily been consistent throughout the years. For example, Brazner & McMillan **(**2008) note that before 1999 observers recorded all turtles as an "unspecified sea turtle", with no differentiation between species. Although NSSA vessels are currently required to record leatherback turtles (listed under SARA), there is a need for improved

observer training, workshops, and/or identification placards. These improvements are currently required under the Day Boat Seafood LLC. client action plan.

To address the issues around observer coverage, Hanke, Andrushchenko, & Croft (2012) emphasized the need for design-based and model-based methodologies for sample selection. For example, Rago *et al.* (2005) developed an observer sea-day model for fisheries, including longline vessels, in the Northeast Atlantic using optimization models and observer data from those fisheries. As such, this methodology may be used by fisheries to meet multiple requirements for stock assessments and ETP species conservation while having a finite number of resources. Similarly, Cotter (2002) uses the probability proportional to size (PPS) sampling method in the English North Sea cod fishery to account for the small number of observers available. Therefore, the fact that DFO funds no longer support the observer program of the Canadian Northwest Atlantic longline swordfish fishery should not serve solely as a reason for keeping the observer coverage level stagnant at ~5-10%.

In general, there have been numerous studies pointing to the necessity of improved observer coverage. For example, Beerkircher, Brown, & Restrepo (2009) noted that the estimates of total discards in the Gulf of Mexico longline fishery improved in precision up to 40% coverage. Similarly, Hanke *et al.* (2012) state that observer coverage needs to be between 20-30% for a fishery with 1000 sets and at 10% for a fishery with 2000 sets in order to account for variation (e.g. outliers) during post-hoc data analysis. In other words, observer coverage can be reduced as the number of sets in the fishery increases, given that larger sample sizes will continue to provide good data (Kell, Arrizabalaga, & de Urbina, 2010, as cited in Hanke *et al.*, 2012). However, it should be noted that the fishery size, encounter probabilities with bycatch species, and the number of positive sets and target catch data are also important when

determining observer coverage levels (Amandè *et al.,* 2010). According to Babcock, Piktich, & Hudson (2003), observer coverage should be set at 50% for bycatch species composing less than 0.1% of catch. However, in order for species to be designated as a 'main' species under MSC certification, they have to compose more than 5% of the total UoC catch or more than 20% of the total catch (Figure 6). A critique of this discrepancy is outside the scope of this study.

In contrast to the client action plan of NSSA, Day Boat Seafood LLC. stated that they would increase their observer coverage to 100% by end of certification period. According to Beerkircher, Brown, & Lee (2002), the observer coverage is randomly allocated amongst vessels in the Southeast US North Atlantic longline and handgear buoy line fishery based on the previous year's fishing effort and the calendar quarter in the Florida East Coast (FEC) statistical reporting area. Even though the NMFS (2004) identifies that 20-30% coverage may be used in conjunction with other actions, the Day Boat Seafood LLC. has made efforts to move beyond this expectation.

The Southeast US North Atlantic longline and handgear buoy line fishery is required to report all species caught in the Fisheries Logbook System (FLS). According to Garrison (2005), reporting rates are relatively high and closely monitored. However, it is noted that under-reporting of bycatch species is possible. This under-reporting may be accounted for using total effort, number of hooks, and fishing area and calendar quarter to ensure bycatch estimates are still accurate. The categories used for logbook recording are: the number of swordfish and tuna, sharks, 'other species', and protected species (MRAG, 2011). This fishery is also required to provide information on the nature of the interaction, their condition upon release, and if there was lost gear involved in the interaction (i.e. if gear was removed or not). In contrast, although NSSA is also required to report information on the nature of interactions with bycatch species,

they only need to report those listed under SARA. Therefore, information on other bycatch species in these logbooks should only be considered as anecdotal. As such, NSSA should take the initiative to require the reporting of all bycatch species within their longline fleet. These logbooks can then be further subjected to an auditing system that assesses data accuracy (e.g. using at-sea electronic monitoring).

Training programs, workshops, and pilot projects in collaboration with other institutions are key elements for furthering research and development in bycatch management. NSSA's Canadian Northwest Atlantic longline swordfish fishery has had past training for observers in July 2011. This was only stated under the PI 2.3.1 condition, and therefore it is unknown whether this training only applied to sea turtles or if it also extended to sharks. In furthering best handling of sea turtles, the client action plan for the PI 2.3.1 condition indicates that K. Martin of the Canadian Sea Turtle Network took the US training/certification program for the safe handling and release of sea turtles. As such, Martin is expected to provide this service to the Canadian Northwest Atlantic longline swordfish fishery "in the future" (IMM, 2013b, p**.** 41). There is no tentative date given for this training to take place, meanwhile this training is mandatory every three years for those in the Southeast US North Atlantic longline and handgear buoy line fishery. Therefore, 100% of the vessels part of the Day Boat Seafood LLC. are certified under this program. Day Boat Seafood LLC. is also collaborating with Angler Conservation Education Inc. and NMFS to hold a Florida Logbook Reporting workshop and its Protected Species Safe Handling, Release and Identification workshop, which is also held every three years.

Although Day Boat Seafood LLC. is participating in an at-sea electronic monitoring pilot project, they fail to mention any studies regarding post-capture mortality rates. In contrast, NSSA recognizes the high uncertainty and threat to bycatch species regarding post-capture mortality,

and therefore has included DFO satellite tagging studies for sharks and turtles under its client action plan. While the client is involved in the studies (e.g. tagging sharks), one drawback from this deliverable is that the client is completely reliant on DFO to complete it. Client integration is especially important given that MSC certification is a time sensitive process that requires deadlines to be met and deliverables to be completed. For example, several delays in DFO have resulted in delays in the IFMP and Shark CAP, which are required to be completed under the MSC certification of the Northwest Atlantic longline swordfish fishery. In addition, the satellite tagging study of the shortfin mako shark was noted by IMM to be behind schedule. Furthermore, the sea turtle satellite tagging studies are also behind schedule due to the marine fouling of tags, which have significantly reduced the number of tags that are reporting information (IMM, 2013b).

Overall, most of the deliverables that NSSA is responsible for are providing copies of DFO documents, results of ICCAT stock assessments, and data from CSAS studies. As such, planning deliverables under client action plans should ensure that they can be completed, at least partially, by the client. If not, the client, as in the case of NSSA, runs the risk of not meeting its deliverables, resulting in the failure to improve bycatch mitigation on an incremental or yearly basis.

7.3 Fishing Gear and Bycatch Mitigation Devices

Changes in gear design, rigging or deployment are important measures to mitigate bycatch. Altering these aspects of a fishery is also within the capacity of NSSA to undertake. Currently, NSSA's voluntary Code of Conduct encourages the purchase of safe handling and release equipment for sea turtles, and the transition from J-hooks to circle hooks, which are now voluntarily used by approximately 90% of the Canadian Northwest Atlantic longline swordfish

fishery (Atkinson, 2011). According to Watson *et al.* (2005), circle hooks significantly reduce loggerhead and leatherback bycatch, in addition to reducing the chance of foul hooking. Similarly, circle hooks in the Canadian Northwest Atlantic longline swordfish fishery have been shown to reduce sea turtle bycatch mortality and foul hooking (Atkinson, 2011).

The studies of Curran & Bigelow (2011), Gilman *et al.* (2007), Kim, Moon, An, & Koh (2006), and Promjinda, Siriraksophon, Darumas, & Chaidee (2008) suggest that circle hooks also reduce shark bycatch. However, there are other studies that actually suggest circle hooks lead to more shark bycatch (Alfonso *et al.*, 2011; Bolten *et al.*, 2005; Kerstetter & Graves, 2006; Kim *et al.*, 2007; Sales *et al.*, 2010; Ward *et al.*, 2009; Watson *et al.*, 2005). Conversely, circles hooks have been suggested to reduce post-capture mortality of sharks (Cosandey-Godin & Morgan, 2011). Therefore, more information is needed to assess the effectiveness of a certain hook type on shark bycatch species in the Canadian Northwest Atlantic longline swordfish fishery.

Both the Canadian Northwest Atlantic longline swordfish fishery and the Southeast US North Atlantic longline and handgear buoy line fishery have de-hooking equipment for sea turtles on-board and have transitioned from wire leaders to monofilament nylon leaders, which enable sharks to bite their way free (Cosandey-Godin & Morgan, 2011). However, the NSSA sea turtle Code of Conduct should become mandatory and fully implemented into the license conditions of their longline fleet. For example, circle hooks are mandatory in the Southeast US North Atlantic longline and handgear buoy line fishery, but only voluntary in the Canadian Northwest Atlantic longline swordfish fishery. In addition, it is mandatory in the US fishery to ensure the gangion line is long enough to reach the surface in sets more than 50m in depth to ensure hooked turtles can breathe at the surface, while this is only voluntary in the Canadian fishery (Fuller *et al.*, 2008). Therefore, making the Code of Conduct mandatory will ensure

bycatch measures are undertaken by all NSSA vessels. NSSA should also integrate best catch, handle and release practices for sharks. Lastly, the Code of Conduct should state explicit objectives and guidelines for achieving those objectives, which has been done in other MSC-certified fisheries (see FCI, 2012).

In addition to the lessons learned from the comparative analysis to reduce bycatch in the Canadian Northwest Atlantic longline swordfish fishery, this study has also identified bycatch reduction devices or strategies that should be considered in both fisheries. These relate to: temperature avoidance, reducing soak time, repellents, hook depth, and changes in bait. Temperature avoidance may be used to reduce shark bycatch by fishing on the colder side of fronts (Gilman *et al.*, 2007), while reducing soak time usually decreases the catch and mortality of bycatch species (Diaz & Serafy, 2005; Morgan & Burgess, 2007; Morgan & Carlson, 2010; Ward, Myers, & Blanchard, 2004). However, reducing soak time, along with any bycatch measure, should be tailored to the specific fishery. For example, if the number of sets (or fishing effort) ends up increasing due to a reduction in soak time and consequential reduction in target catch, there should be a means of maximizing both interests within that particular fishery.

Permanent magnets and electropositive or rare earth metals on hooks have been used in studies to create an electric field, which perturbs the electro-sensory system in sharks and causes them to avoid hooks (see Brill *et al.*, 2009; Kaimmer & Stoner, 2008; Swimmer, Wang, & Mcnaughton, 2008). Several fisheries are undergoing studies of such repellents with the use of some becoming mandatory, such as in the Shark Conservation and Management Measure (CMM-2010-07) of the Western and Central Pacific Fisheries Commission (WCPFC; IMM, 2012c). Lastly, hook depth may be used by setting hooks below a threshold depth to reduce shark bycatch. For example, Williams (1999) showed that blue shark, silky shark, and oceanic whitetip

shark bycatch was significantly higher in shallow-set gear versus deep-set gear. Overall, it is important to note that these bycatch mitigation measures should be tailored to the specific fishery, given that there are vast differences between fisheries, such as the bycatch species. Therefore, acquiring more information on bycatch species in each fishery will permit more specific and effect mitigation measures.

Finally, although ghost fishing is not a particular concern in the Canadian Northwest Atlantic longline swordfish fishery (as opposed to demersal longline gear, A. Payne, personal communication, August 28, 2013), there should still be a recognition that lost gear can result in bycatch. This may include a specific statement for lost gear to be recovered and/or reported in DFO management plans, the NSSA Code of Conduct, or IMM conditions. For example, the Denmark North Sea and Skagerrak haddock longline fishery Code of Conduct states "we seek to minimize the environmental consequences of our fishing by … being generally aware of the optimal use of our gear. We do our utmost to bring up lost fishing-gear, help each other with this whenever we can – and when the gear cannot be brought up it is recorded in the attached form" (FCI, 2012, p. 199). Therefore, the MSC certification of the Canadian Northwest Atlantic longline swordfish fishery should ensure all aspects of bycatch mitigation are considered and addressed appropriately.

7.4 Key Recommendations

1. NSSA should be accountable for its deliverables under its MSC certification

Although DFO has formally agreed to support NSSA's client action plan (see Appendix), this does not state their commitment to meeting their deliverables in keeping with the timeline of NSSA's certification. For example, DFO does not specifically state that they will complete the

Canadian Shark IFMP by the second surveillance audit, as written under NSSA's client action plan. Therefore, NSSA runs the risk of losing its certification if DFO does not meet the deliverables they have committed to. As such, NSSA should seek alternative methods in mitigating bycatch, including improved methods for data collection and better measures for avoiding bycatch mortality (see Recommendations 2-7).

2. NSSA should establish their observer coverage in accordance with the best available scientific and technical knowledge

In the Canadian Northwest Atlantic longline swordfish fishery, an average 14-day trip would deploy up to 10 sets (IMM, 2012b). The total number of sets for the fishery should therefore be used to estimate an appropriate level of observer coverage. Recall, Hanke *et al.* (2012) state that observer coverage needs to be between 20-30% for a fishery with 1000 sets and at 10% for a fishery with 2000 sets. Furthermore, previous models used for distributing observers in the Canadian Northwest Atlantic longline swordfish fishery have already been developed for 20% observer coverage, therefore maintaining this level would be ideal. Alternatively, resources may be channeled into determining appropriate observer coverage for this fishery using optimization models (to account for fiscal constraints), existing data from observers and logbooks, and other fisheries.

3. NSSA should make logbook recording mandatory for all species

Currently, the Canadian Northwest Atlantic longline swordfish fishery is only required to record species listed under SARA. Therefore, other bycatch species, particularly species listed as ETP by COSEWIC or IUCN, are not recorded, which provides little data on their current status. For example, the porbeagle shark is not listed under SARA and therefore NSSA is not required

to report this bycatch in their logbooks. Although members of NSSA may identify and record species beyond SARA, this data would only be used as anecdotal, as it is not mandatory across all vessels.

4. NSSA should organize mandatory workshops

Workshops are useful tools for bringing fishermen together, particularly to improve bycatch mitigation in their fishery. Two major urgencies arise from this study, including workshops for (i) bycatch species identification, and (ii) safe handling and release of sea turtles and sharks (by K. Martin from the Sea Turtle Conservancy). Bycatch species identification would be critical for logbook reporting, though this should be implemented in conjunction with Recommendation 3. Furthermore, although there are multiple sources for safe handling and release of sea turtles and sharks, a workshop for NSSA would ensure measures are implemented consistently throughout their fishery.

5. NSSA should pursue at-sea electronic monitoring

At-sea electronic monitoring is a useful tool to increase (i) compliance, and (ii) accuracy of data. Not only can CCTV be used to ensure IUU fishing is not occurring on the vessel, it can also be used to audit logbooks and observer data. Electronic monitoring may also extend to electronic logbooks, where data are provided and received in real-time. Pilot projects are currently being carried out across MSC-certified fisheries (in collaboration with external research institutions), and therefore should also be considered by NSSA.

6. IMM should add shortfin mako sharks back into the PI 2.1.1 and 2.1.2 conditions

In accordance with the precautionary principle, IMM should add shortfin mako sharks back into the conditions. It was unrealistic for IMM to fully depend on ICCAT's stock assessment of the shortfin mako shark to determine if it was within its biologically based limits. Recall the critiques of Cullis-Suzuki & Pauly (2010) and Levesque (2010) regarding ICCAT assessments and their methods of data collection. Furthermore, the post-release mortality of the shortfin mako shark in the Canadian Northwest Atlantic longline swordfish fishery is largely unknown. Therefore, it was premature to remove this species completely from the conditions, as this also removed the deliverables under the client action plan regarding the post-release mortality study. Although this study continues to be recommended by IMM, it is no longer mandatory under the fishery's certification.

7. NSSA should fully implement its voluntary Code of Conduct into the license conditions

NSSA's Code of Conduct includes gear changes, as well as safe handling and release equipment for sea turtles. However, this code is voluntary, and therefore all NSSA members are not required to implement these. As such, it is important that this Code of Conduct is made mandatory under the fishery's certification, potentially through the fishery's license conditions, and continues to include up-to-date measures for bycatch mitigation in this fishery. This code should also extend to the best catch, handle, and release practices of sharks.

CHAPTER 8: CONCLUSION

The MSC certification of NSSA's Canadian Northwest Atlantic longline swordfish fishery provides an opportunity for improved bycatch mitigation. Although this certification illustrates the initiative and commitment from this fishery to be more sustainable, there are a number of areas in need of improvement. In particular, NSSA's client action plan needs to include more specific and realistic expectations, as well as client accountability. Most broadly, NSSA needs to present a plan for improved bycatch data collection and mitigation that is within their capacity to complete. While much of their client action plan depends on the work of DFO and ICCAT, there are still deliverables that can be achieved independent of this work and assumed by the client themselves. These include improving the quality and quantity of observer coverage, recording all bycatch species in logbooks, and fully implementing the NSSA Code of Conduct into the longline license conditions. Therefore, it is recommended that these improvements are considered at the second surveillance audit in order to move towards a more sustainable swordfish fishery. Furthermore, it is recommended that these lessons be considered in other MSC-certified fisheries for mitigating bycatch, subject to the specificity of the fishery being certified.

8.1 FUTURE DIRECTIONS

The scope of this study mainly focused on NSSA's deliverables and client action plan regarding the initiative to mitigate bycatch in the fishery. However, further research is needed to examine the consistency of CABs and how they approve plans and certify fisheries. The approval of client action plans can vary considerably across different CABs, potentially attributed to ambiguous or restricting MSC guidelines. Therefore future studies should look into

the reliability and expert consistency of these third-party certifiers and provide recommendations for moving forward.

Overall, the main objective of MSC is to transform the seafood market to a sustainable basis, and therefore is not the panacea for global sustainable fisheries. However, by improving its fishery certification program and subsequently strengthening its eco-label, MSC can play a large role in ensuring the sustainability of fisheries worldwide.

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APPENDIX

DFO SUPPORT FOR NSSA'S MSC CERTIFICATION

Fisheries and Oceans / Pêches et Océans

P.O. Box 1035
Dartmouth, NS
B2Y 4T3

AUG 04 2011

Mr. Troy Atkinson
Nova Scotia Swordfishermen's Association
155 Chain Lake Drive
Halifax, NS B3S 1B3

Re: Fisheries and Oceans Canada Support for Marine Stewardship Council Revised Action Plan

Dear Mr. Atkinson,

This letter is to advise you that Fisheries and Oceans Canada Maritimes Region (DFO) agrees to support the revised Action Plan you have drafted for the Swordfish longline fishery. I note that the three new Conditions that have been added, as well as the others that I reviewed previously, align with the department's management processes and many of our planned activities. Regarding those Conditions that reference necessary actions related to ICCAT, I would like to reiterate that Canada cannot assure specific actions on the part of that group. Notwithstanding that caveat, the Department remains interested in working with you to develop a more detailed work plan which will define timelines and accountabilities that touch on areas of DFO authority.

Please note that this work plan will be reviewed on an annual basis to assess its alignment to DFO's annual plans and priorities. As a result additional internal review will be required in advance of DFO commencing activities to support the Action Plan.

I would like to take this opportunity to once again commend your members for their on-going commitment to a sustainable fishery and wish you all the best in your effort to become Marine Stewardship Council certified.

Yours sincerely,

Faith G. Scattolon
Regional Director-General
Maritimes Region