The application of the ecosystem approach and future directions for the international management of migratory sharks in the Northwest Atlantic

By

Travis Aten

Submitted in partial fulfillment of the requirements for the degree
Of
Master of Marine Management at

Dalhousie University
Halifax, Nova Scotia

December 2016

Aten, Travis. (2016). The application of the ecosystem approach and future directions for the international management of migratory sharks in the Northwest Atlantic [graduate project]. Halifax, NS: Dalhousie University.

Abstract

Sharks have existed on Earth for over 400 million years. However, many shark populations have declined and show only slow to no signs of recovery. Many sharks are apex predators and therefore play crucial roles in maintaining ecosystem stability and resilience. The decline in shark populations is especially true for the large, pelagic, and migratory sharks of the Northwest Atlantic (Porbeagle, Shortfin Mako & Blue Shark). Anthropogenic factors such as finning, overfishing and bycatch are the top causes pushing these shark populations into decline.

Recently, sharks have rapidly gained more attention within the international realm. New frameworks such as the International Plan of Action-Sharks, Memorandum of Understanding-Sharks and United Nations General Assembly Resolutions have or are attempting to improve shark management on the high seas by incorporating the ecosystem approach. Sharks within the high seas are the responsibility of regional fisheries management organizations (RFMOs). Two RFMOs in the Northwest Atlantic, the Northwest Atlantic Fisheries Organization (NAFO) and International Commission for the Conservation of Atlantic Tunas (ICCAT) have attempted to properly manage and conserve shark populations from an ecosystem approach. However, populations are still in decline.

Therefore, this project has attempted to answer whether or not ICCAT and NAFO truly have been applying the ecosystem approach towards international shark management in the Northwest Atlantic. To understand whether or not NAFO and ICCAT are applying the approach this project conducted a policy analysis of all relevant international frameworks that govern the high seas and RFMOs, created indicators for the ecosystem approach and determined whether or not shark measures within NAFO and ICCAT abide by the indicators, completed a comparative analysis of how other RFMOs manage sharks to determine if NAFO and ICCAT are on par with the other RFMOs, and provided recommendations and future directions for international shark management in the Northwest Atlantic.

Pathways to successful shark management are possible and perhaps even simple within the Northwest Atlantic. The evidence suggests that NAFO and ICCAT have only partially been applying the ecosystem approach, even though international frameworks have been calling and continue to call for the application of the approach towards sharks. Furthermore, NAFO and ICCAT are not leaders compared to other RFMOs when it comes to managing migratory sharks. International shark management has to make great strides in the near future if shark populations are persist at viable levels.

Keywords: international shark management, regional fisheries management organizations, Northwest Atlantic Fisheries Organization, International Commission for the Conservation of Atlantic Tunas, ecosystem approach, international shark governance, international environmental law, international fisheries law.

Acronyms

CCAMLR – Convention for the Conservation of Antarctic Marine Living Resources
CCSBT – Commission for the Conservation of Southern Bluefin Tuna
CP – Contracting Parting
CPC – Cooperating non-Contracting Party
CBD – Convention on Biological Diversity
CITES – Convention on the International Trade in Endangered Species of Wild Flora and Fauna
CMS – Convention on the Conservation of Migratory Species of Wild Animals
EAF – Ecosystem Approach towards Fisheries
FAO – Food and Agriculture Organization
IATTC – Inter-American Tropical Tuna Commission
ICCAT – International Commission for the Conservation of Atlantic Tunas
IOTC – Indian Ocean Tuna Commission
IPOA – International Plan of Action
IUU – Illegal, Unreported and Unregulated
IWC – International Whaling Commission
MOU – Memorandum of Understanding
NAFO – Northwest Atlantic Fisheries Commission
NASCO – North Atlantic Salmon Conservation Organization
NEAFC – North-East Atlantic Fisheries Commission
NPOA – National Plan of Action
RFMO – Regional Fisheries Management Organization
TAC – Total allowable catch
WCPFC – Western and Central Pacific Fisheries Commission
UN – United Nations
UNCLOS – United Nations Convention on the Law of the Sea
UNFSA – The United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks
UNGA – United Nations General Assembly

Table of Contents

List of Figures

List of Tables

Appendices

Introduction

It is estimated that over 100 million sharks are taken from the oceans every year (Worm et al., 2013). The rate of extraction of sharks from the oceans through overfishing, shark finning and heavy bycatch combined with the biological vulnerability of sharks is making the sustainability of many shark species nearly impossible. Studies show that globally shark populations are declining at substantial rates. This is particularly true for migratory sharks in the Northwest Atlantic (Baum et al., 2003). Of the three major migratory sharks in the Northwest Atlantic the porbeagle and shortfin mako are listed as vulnerable by the IUCN, while the blue shark is listed as near- threatened (Cailliet et al., 2009; Camhi et al., 2009).

These migratory sharks are especially in danger of extinction because of the lack of protection provided for organisms within the high seas. International frameworks and laws have little harmony and are fragmented, making the possibility of protecting shark species through international treaties slow or unlikely (Techera, 2011). Furthermore, the lack of global cooperation and political will by nation-states only decreases the chances of sharks being properly managed (Alder et al., n.d.).

However, international law and frameworks call for the application of the ecosystem approach when it comes to managing sharks (Alder et al., n.d.). If properly applied, scientists and academics believe that the ecosystem approach could be the key to sustainably managing migratory shark species within the Northwest Atlantic (FAO, 2008).

The responsibility of applying the ecosystem approach towards international shark management in the Northwest Atlantic falls primarily into the hands of regional fisheries management organizations (RFMOs), specifically the Northwest Atlantic Fisheries Organization

(NAFO) and the International Commission for the Conservation of Bluefin Tunas (ICCAT). The 1995 United Nations Fish Stocks Agreement (UNFSA) solidified and gave RFMOs the responsibility and authority to manage and conserve straddling fish stocks and highly migratory fish stocks to ensure the long-term sustainability of species (A/CONF.164/37, 1995).

Both NAFO and ICCAT are required to and call for the application of the ecosystem approach when it comes to managing all their respective species on the high seas. However, since shark population numbers have precipitously dropped in the Northwest Atlantic there needs to be some form of examination as to whether or not the ecosystem approach is being applied towards sharks by these RFMOs. The evidence suggests that NAFO and ICCAT have not been fully applying the ecosystem approach when it comes to international shark management and rather sharks have been put on the backburner. Furthermore, the same can be said for other RFMOs, while alternatively there are RFMOs who have made great strides in the conservation, management and application of the ecosystem approach towards sharks.

The loss of sharks within the Northwest Atlantic and globally could have significant negative implications felt throughout entire ecosystems and have direct impacts on the way in which humans interact with them (PEW Environment Group, 2012). It is clear that current conservation and management measures at the regional and international levels are falling short of the efforts required to properly conserve sharks. Future directions and recommendations concerning how to successfully manage sharks on the high seas are well researched and within reach. However, a lack of capacity and political will has made it difficult to apply the recommendations. Therefore, RFMOs and nation-states must continue to work cooperatively to strengthen the frameworks already in place to ensure the survival of shark species. For the time

being, it is clear that NAFO and ICCAT have only partially been able to apply the ecosystem approach towards managing porbeagles, shortfin makos and blue sharks in the Northwest Atlantic and likely have a long way to go before successful management is reached.

The chapters for this project occur in the following order: Chapter 1 examines the biological characteristics of sharks. Chapter 2 discusses both the economic and environmental importance of sharks for humans and ecosystems. Chapter 3 explores the current state of shark populations globally and within the Northwest Atlantic. Specifically, Chapter 3 observes the current population status of porbeagle, shortfin mako and blue sharks. Chapter 4 explores the governance of sharks within the high seas by critically examining relevant binding and non-binding international instruments responsible for managing sharks within the high seas. Chapter 5 inspects the ecosystem approach and how it can aid in the international management of sharks. Chapter 6 discusses the role of RFMOs in managing sharks and reviews the current shark management measures for NAFO and ICCAT. Chapter 7 explains the methodology for this graduate project. Chapter 8 analyzes the application of the ecosystem approach towards shark management for NAFO and ICCAT. Chapter 9 comparatively analyzes how seven other RFMOs within the high seas manage sharks in order to compare to NAFO's and ICCAT's shark management regime. Chapter 10 is a discussion regarding the international management of sharks and the results of this project. Chapter 11 provides global and regional recommendations for international shark management with a section dedicated to discussing the potential for an 'International Shark Commission'. Finally, Chapter 12 concludes that the ecosystem approach has only partially been applied by NAFO and ICCAT.

1. **Chapter 1** – *The Chondrichthyes*

Sharks, rays, skates and chimaeras belong to the cartilaginous fishes (Chondrichthyes) rather than to the bony fishes (Osteichthyes). The Chondrichthyes are referred as cartilaginous fishes because their skeletons are comprised of cartilage, a substance less calcium-impregnated than bone (Klimley, 2013). The Chondrichthyes have several distinguishing features such as articulated jaws, paired fins and denticles (see Figure 1). The Chondrichthyes can be divided into two subgroups: chimaeras (rat fish, spook fish and rabbit fish) and the better known elasmobranchs (includes sharks, skates and rays), with sharks being the focus of this project (Townsend, 2012). There are roughly over 400 species of sharks in the wild (The Shark Research Institute, 2016).

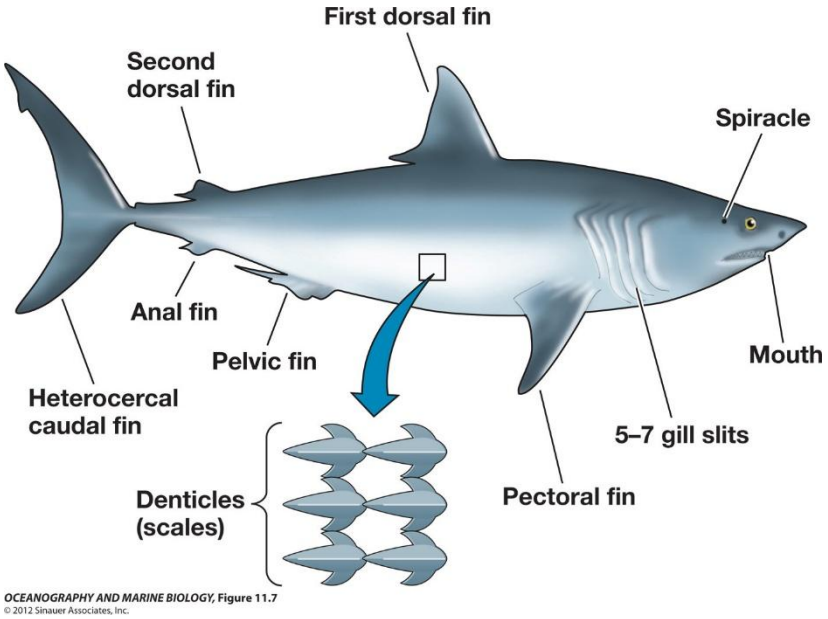


Figure 1: Anatomy of a shark

Sharks have evolved over the last 400 million years to become the dominant predators of the oceans (Verlecar et al., 2007). Sharks are distributed across the globe, from cold polar waters to the warm waters of the tropics, and occupy depths of the water column between surface water and deep water (Ecologically Related Species Working Group, 2011). Furthermore, some sharks migrate vast distances while others do not migrate at all (Vannuccini, 1999). Along with being well distributed across the oceans, sharks come in a variety of sizes (see Figure 2) and have adapted different methods of surviving within their ocean ecosystem (Townsend, 2012).

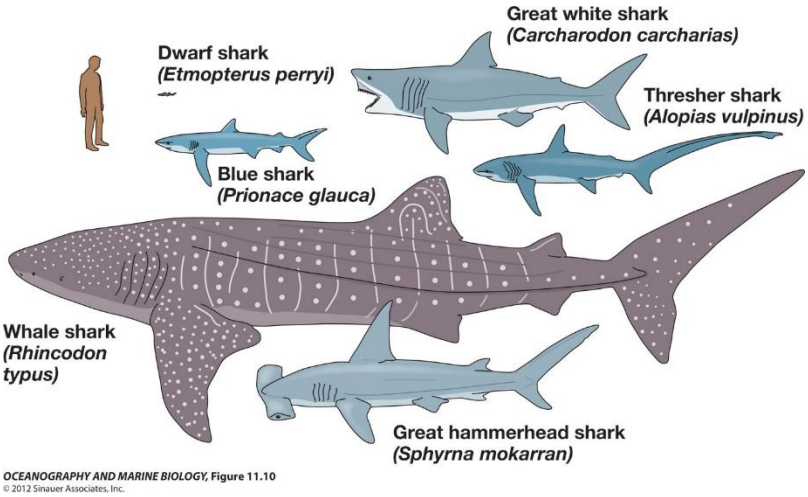


Figure 2: Different shark sizes

Sharks are predatory animals and are integral parts of marine ecosystems. Located on the third and fourth trophic levels, many sharks are considered apex predators within ecosystems (Klimley, 2013). Relatively smart predators, sharks have efficient sight, and smell (Ecologically Related Species Working Group, 2011). Different feeding methods exist depending on the shark species. For example, the basking shark skims the water with an open mouth to filter in plankton. On the other hand, some sharks such as the blue shark attack and eat other marine animals (Townsend, 2012).

Unlike the bony fishes, many shark species give birth to relatively few offspring. Depending on the species, some sharks can produce thirty embryos per year while others produce only two embryos (Klimley, 2013). Once newborn sharks hatch it can take a long time before a shark reaches maturity. For example, blue sharks mature at four to six years for males and five to seven years for females. Shortfin mako sharks are mature at seven to nine years for males and eighteen to twenty-one years for females (Ecologically Related Species Working Group, 2011). Many are long-lived, with some reaching the age of thirty-five while others living to be eight or ten. Some estimates indicate that Greenland sharks can live to be over four-hundred years old (Klimley, 2013). Therefore, sharks can be characterized by having slow

growth, long lives, late age of maturity and relatively few young. All of which can make sharks vulnerable to an array of factors (Lack & Sant, 2011).

Sharks have dominated the seas for over 400 million years, have relatively few natural predators and have thrived at the top of the food chain; however, this is starting to change. The biological characteristics of sharks make them vulnerable to many anthropogenic factors. Humans extract over one hundred million sharks from the ocean each year (Verlecar et al., 2007). This unsustainable extraction of sharks from the oceans, coupled with the biological vulnerability of sharks is causing shark species to decline and in some cases disappear (Klimley, 2013). If action is not taken scientists anticipate that over 20 species of sharks will become extinct by 2017, with more shark extinctions in the years to follow (Verlecar et al., 2007).

2. **Chapter 2** – *Importance of Sharks*

Humans tend to have negative perceptions of sharks compared to other animals (e.g. whales). However, this negative perception of sharks is perhaps unjustified and ill informed (Verlecar et al., 2007). Instead, sharks are of great importance to humans and ocean ecosystems both **economically** and **environmentally**.

2.1 Economically

Historically humans have used sharks as a food source and over time entire industries have focused on sharks. Sharks are used for their meat, dry or fresh and other shark parts are used for medicinal, decorative and cultural purposes. For example, gelatin found within sharks is used as a food source, teeth are used as jewellery and shark liver oil has pharmaceutical benefits (Ecologically Related Species Working Group, 2011). Additionally if sharks are fished sustainably, they provide livelihoods to many fishers. For example, Canada once had a porbeagle fishery until 2013 when it was discontinued because of low porbeagle population numbers (Bedford Institute of Oceanography, 2015). Furthermore, small developing nations depend on shark catches to generate income but shark populations are continuing to decline worldwide (Lack and Sant, 2011). However, there has recently been a small shift towards shark ecotourism rather than shark fishing (Klimley, 2013).

It is estimated that shark watchers/divers generate $314 million USD per year and directly provide 10,000 jobs in the sector worldwide. By comparison, the landed value of global shark fisheries is currently $630 million USD and declining. Additionally, there are projections that demonstrate that there will be an increase in shark watchers/divers in the next twenty years, which could equal almost $780 million USD per year (see Figure 3). Furthermore, a vast amount

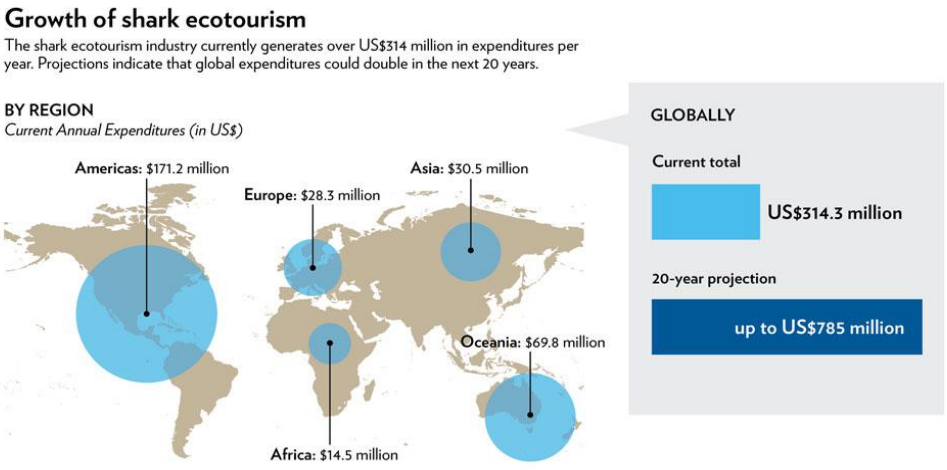


Figure 3: Growth of shark ecotourism (Source: Cisneros-Montemayor et al., 2012)

of shark watching takes place in developing nation-states, directly influencing nation-states' economies in positive ways (Cisneros-Montemayor et al., 2012). The economic benefits of shark watching/diving are evident and will more than likely outweigh the value of harvest shark fisheries in the future. For example, the Maldives recently banned shark fishing within their domestic waters because officials realized that shark watching within the Maldives generated greater income from shark tourism than from shark fisheries. In 1992 shark tourism (mainly whale shark excursions) earned the Maldives $2.3 million USD, while shark products were only valued $700 000 USD (Timms and Williams, 2009). Additionally, in the Bahamas a single reef shark is worth $250 000 as a result of shark ecotourism compared to the onetime $50 value when caught by a fisher. A whale shark in Belize can bring in over $2 million USD in its lifetime (Griffin, et al., 2008). Therefore, the evidence suggests that there are great benefits in a shift from unsustainable shark fishing towards more sustainable practices. The conservation of sharks for ecotourism could be an essential pillar in establishing the livelihoods of individuals and families to come.

The loss of great shark populations in North Carolina clearly demonstrates the importance of shark species. Due to human fishing practices the large shark populations

diminished allowing for ray populations to increase (rays are hunted by sharks). As a result, the more abundant rays ate all the bay scallops, forcing the scallop fishery to close (Griffin, et al., 2008). This example not only demonstrates the economic impact that declining shark populations can create but environmental implications that occur once shark populations decline.

2.2 Environmentally

Sharks not only have an important role economically, but they also have important roles environmentally. Sharks are important because many are apex predators and play a crucial role in the ecosystem by maintaining ecosystem biodiversity (e.g. the ray population in North Carolina) (Myers et al. 2007; Stevens et al., 2000). By doing so, sharks also act as indicators of ocean health. If sharks do not regulate the abundance of certain species than there will be rapid growth of a few species, which can greatly alter ecosystems and cause trophic cascading. Studies prove that more apex predators within an ecosystem equal more diverse species (Wirsing et al., 2007). The more diversity within an ecosystem the healthier the ecosystem will be, supporting the need for healthy shark populations.

Indirectly, sharks are able to help maintain ecosystems. For example, the loss of sharks in coral reef habitats has led to the decline in coral reefs and in return the loss of commercial fisheries (Stevens et al., 2000). Taking sharks out of coral reefs allows large predatory fish such as groupers to increase and feed on herbivores. Less herbivores means more macro algae which corals and coral reefs cannot compete with, ultimately shifting the coral reef ecosystem into a less predictive and less diverse ecosystem dominated by macro algae (Griffin et al., 2008).

Apex predators such as sharks do not only impact population dynamics and diversity but also control the spatial distribution of potential prey through intimidation. This fear of being

preyed upon causes some species to alter their habitat use. For example, this is important because dugongs (prey of some sharks) heavily graze sea grass. When shark abundance is high in a certain area the dugongs are forced to eat lower quality sea grass elsewhere to avoid predation, allowing the sea grass to grow back in other areas (Wirsing et al., 2007). Therefore, sharks can regulate certain habitats that provide life and support ecosystems. Finally, not only do sharks regulate species abundance, distribution, and diversity, but they also provide essential food sources for scavengers such as Remoras (Griffin et al., 2008).

Getting rid of apex predators can have far-reaching impacts. Despite a rich ecological literature surrounding trophic cascades many of the consequences of removing apex predators remain uncertain (Myers et al., 2007). The conservation and proper management of sharks must be a priority if humans want ocean ecosystems to remain healthy and resilient not only from anthropogenic pressures, but also from climate change pressures.

3. **Chapter 3** – *Current State of Shark Populations*

As the previous chapter explained, sharks have very high economic and environmental importance for humans. However, until recently it would seem that humans have not realized the importance of sharks because shark populations have and are continuing to dwindle at drastic rates (Verlecar et al., 2007). This chapter will discuss the current state of shark populations globally and then examine the regional state of porbeagle, shortfin mako and blue shark populations within the Northwest Atlantic Ocean.

3.1 Globally

Globally, many shark populations are in trouble. The International Union on the Conservation of Nature (IUCN) has assessed the extinction risk of 480 species of sharks. The results are that 43% (209 species) are data deficient and therefore the IUCN cannot assess the species extinction risk. More than half of the species with enough information to determine conservation status (180 species) are threatened or near-threatened with extinction. Of the 62 highly migratory shark species with enough data to allow for a full assessment, 82% (51 species) are considered threatened or near-threatened (PEW Environment Group, 2012). Despite the poor conservation status of global shark populations only nine species, the basking, whale, porbeagle, oceanic whitetip, sawfish, scallop hammerhead, smooth hammerhead, great hammerhead and great white shark have any global management measures in place (CITES, n.d.; Worm et al., 2013). Thus, on a global scale, few shark populations are protected.

The global catch and mortality of sharks from reported and unreported landings, discards and shark finning are estimated at 1.44 million metric tons for the year 2000 and 1.41 million metric tons for 2010 (see Figure 4); showing only a slight difference in shark mortality over ten years, even though scientists and nation-state officials knew about declining shark populations in the early 2000s (Baum et al., 2003; Worm et al., 2013).

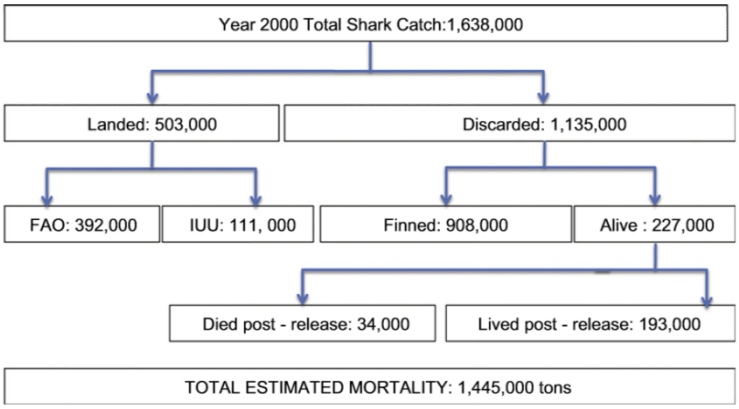


Figure 4: Estimating global shark mortality for the year 2000. Included are reported (from FAO) and illegal, unreported, and unregulated (IUU) landings as well as shark discards. Total mortality was calculated as the total catch minus the number of sharks which survived discarding. All figures were rounded to the nearest 1000 metric tons (Source: FAO, 2012).

Tropical sharks, migrating sharks, deep water sharks and other types of sharks have all shown recent population declines (Baum et al., 2003; Robbins et al., 2006). Furthermore, the fisheries exploitation rate of sharks per year ranges from 6.4% - 7.9%. However, the rebound rates for shark population's averages 4.9% per year and therefore, explains the ongoing decline in many shark populations (Worm et al., 2013). The global total shark mortality must change if shark populations are to persist at healthy levels.

3.2 Northwest Atlantic Populations

Although shark populations are decreasing globally, this project will focus on three particular shark populations within the Northwest Atlantic: the porbeagle, shortfin mako, and blue shark. All three shark species have seen massive declines in the past fifty years (ICCAT, Executive Summary 8.13 SHK – Sharks, 2015). Baum et al. discovered that all three species of

sharks have declined by more than fifty percent in the past fifteen years in the Northwest Atlantic (2003); illustrating the fact that there needs to be a focus on the conservation and proper management of dwindling porbeagle, shortfin mako and blue sharks in the Northwest Atlantic.

3.2 A. Porbeagle (*Lamna nasus*)

Under the IUCN Red List, the porbeagle is listed as vulnerable with current population trends decreasing. Major threats to porbeagle populations in the Northwest Atlantic consist of the high value of porbeagle meat leading to exploited bycatch of the population, and a low reproduction rate for the species (Stevens et al., 2006). The Northwest Atlantic porbeagle population is defined by individuals located north of 35ºN and west of 42ºW, which corresponds roughly to ICCAT region BIL 94B and NAFO areas 0-6 (ICCAT, 2009).

Although there are still disagreements regarding the abundance of porbeagle in the Northwest Atlantic, there is much more data surrounding porbeagle populations than shortfin mako and blue shark, making populations assessments more accurate. An ICCAT stock assessment of porbeagle in 2009 yielded that there has been a 66% decline since 1961 (2009). The Department of Fisheries and Oceans (DFO) in Canada reported that porbeagle populations are only 22%-27% of 1961 levels and mature females currently make up only 6% of the population. However, there is some evidence that suggests that new conservation measures in place have halted the decline of the Northwest Atlantic population (Campana et al., 2012). A Bayesian Surplus Production Model (BSP) predicted that if no porbeagle fishing were to occur this population would recover to a stable biomass size in twenty years (ICCAT, 2009). It is evident that the porbeagle population in the Northwest Atlantic has decreased significantly since 1961 and the population is now at critically low levels.

3.2 B. Shortfin Mako (*Isurus oxyrinchus*)

Under the IUCN Red List the shortfin mako is considered to be vulnerable with current population trends as decreasing. The main causes of shortfin mako decline consist of bycatch from long-line pelagic fisheries and low reproduction rates (Cailliet et al., 2009). A current stock assessment completed by ICCAT illustrates that in general the status of the North Atlantic population is healthy compared to the past and the probability of overfishing is low; however, the results also show inconsistencies between estimated biomass trajectories and CPUE[1] trends, "producing wide confidence intervals in estimated trajectories and other parameters (ICCAT, 2012)." Additionally, the evidence available suggests that there has been a forty percent decline in population abundance since 1986, but this information needs to be interpreted with caution because the analysis was not based on the full range of available data (Canadian Science Advisory Secretariat, 2007). This information means that shortfin mako population abundance could be lower than expected. With most shark populations the lack of scientific data makes it difficult to generate accurate estimates of stock status and abundance, which is why ICCAT's Scientific Council has made it clear that fishing mortality of shortfin mako should not increase until more data can be collected (Cailliet et al., 2009). Based on life history characteristics the recovery potential of shortfin mako in the Northwest Atlantic appears to be better than for porbeagle, but not as good as that of the blue shark (Canadian Science Advisory Secretariat, 2007).

3.2.C Blue Shark (*Prionace glauca)*

Under the IUCN Red List the blue shark is considered near-threatened with no information regarding current population trends. Major threats to blue shark consist of bycatch due to long line fisheries and sport fishermen catching blue shark as bycatch (Stevens, 2009).

[1] Catch Per Unit Effort (CPUE) is an indirect measure of the abundance of a target species (Lodge, 2008).

Although not as worse off as the porbeagle and shortfin mako, the information surrounding blue shark abundance is low, making it difficult to predict population size (ICCAT, Executive Summary 8.13 SHK – Sharks, 2015).

ICCAT with the available data has attempted to complete full population assessments of blue shark populations. A 2004 stock assessment demonstrated that the biomass of blue sharks in the Atlantic Ocean is believed to be above the biomass that would support maximum sustainable yield (MSY) (ICCAT Blue Shark Assessment, 2015). However, it has been reported that specifically within the Northwest Atlantic there has been a net decline of blue sharks of 60% from 1986-2000, this demonstrates the high uncertainty when estimating the stock status and population abundance of blue sharks in the Northwest Atlantic (Campana et al., 2015).

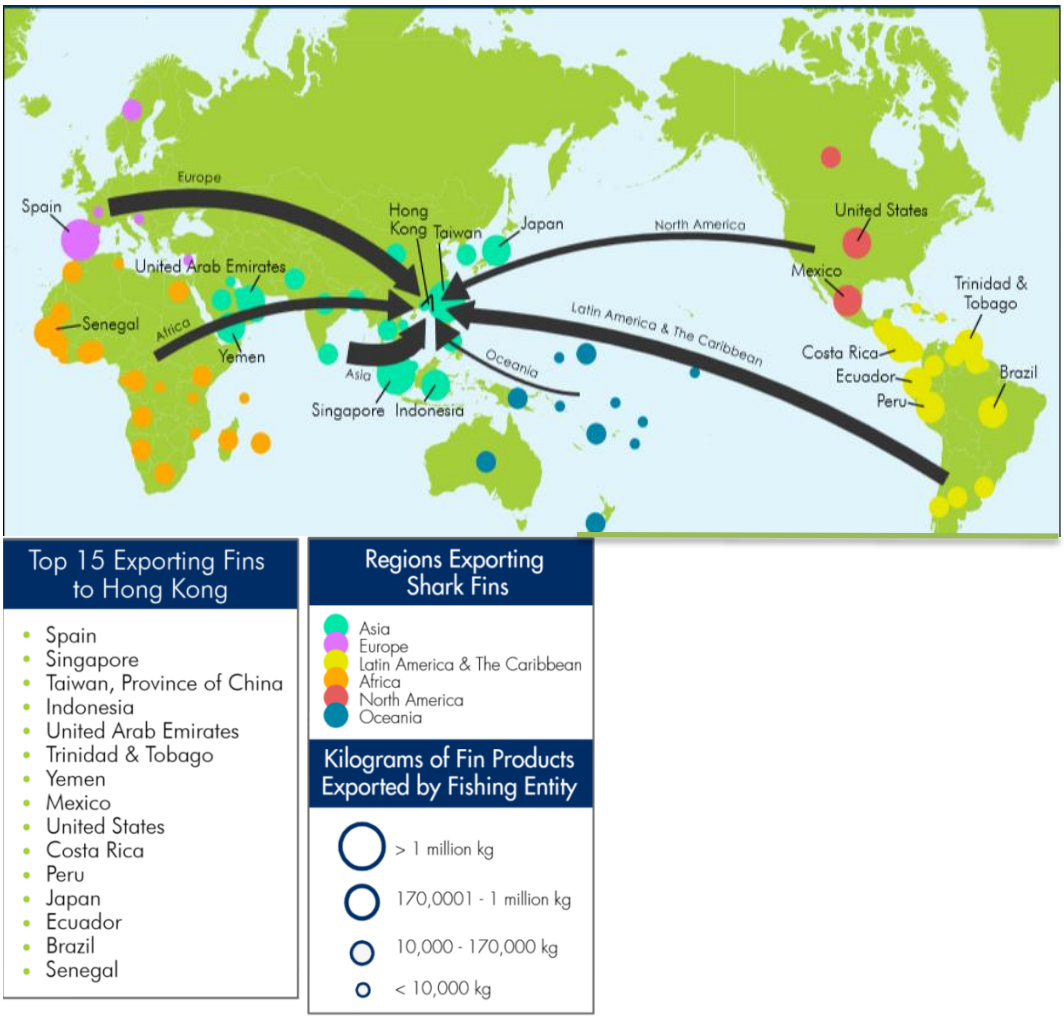
It must be noted that porbeagles, shortfin makos and blue sharks are not the only shark species found within the Northwest Atlantic. Deep water sharks, and skates can be found within the area as well. However, due to the lack of information surrounding deep water sharks, and skate's small migratory nature, they fall out of the scope of this project (Camhi et al., 2009).

3.3 The decline of sharks

Only in the past half century when fishing fleets expanded rapidly within the open ocean were declines of shark populations observed (Baum et al., 2003). There are five mains reasons for dwindling populations in the Northwest Atlantic. These same five reasons can also be attributed to the main decline of migratory sharks globally (Myers et al., 2007; Pew Environment Group, 2012).

The first reason for declining shark populations in the Northwest Atlantic has to do with overfishing. The demand for sharks has risen greatly compared to the past. Sharks can now sell for up to $700 USD per kilogram and the global shark trade is estimated to be worth $ 1 billion CAD annually (Dent and Clarke, 2015). The high price for sharks creates a lucrative business along with the incentives to fish/overfish sharks. Additionally, the high value of shark fins encourages shark finning, a destructive and wasteful practice where the fins are cut off the shark and the carcass is discarded because of its comparatively low value (Spiegel, 2001). Over eighty-three countries exported more than 10.3 million kilograms of shark fin products to Hong Kong in 2011, demonstrating that the shark fin trade is truly global (see Figure 5). (Pew Environment Group, 2012).

Figure 5: 2011 Imports of shark fins to Hong Kong (Pew Environment Group, 2012)



The open ocean is huge, making it difficult to monitor accurately all fishing activity that occurs within and is therefore, prone to overfishing, making the exploitation rates of sharks largely unknown (Baum et al., 2003; Worm et al., 2013). The lack of data surrounding the over-exploitation of sharks combined with the high demand is one of the reasons that explain the decline in shark populations.

The second reason for declining shark populations in the Northwest Atlantic involves bycatch. Bycatch occurs when a shark is caught incidentally by fishing gear such as long lines, trawls and seine nets set for other types of fish. Additionally, many sharks caught as bycatch will simply be discarded, without knowing if the shark will survive or not (WWF, 2016). For example, the lucrative tuna industry within the open ocean in the Northwest Atlantic creates high bycatch levels of shark populations (Baum et al., 2003).

Thirdly and aforementioned, sharks lifecycles make it difficult for sharks to survive and reproduce when under pressure due to unsustainable fishing. Sharks have low reproductive rates, late maturity, and slow growth, meaning that it takes a long time for many shark populations to recover (Worm et al., 2013).

Additionally, habitat destruction in some regions and for some species have been linked to population declines. However, the linkage is often indirect and is thought to have little impact on sharks in the Northwest Atlantic as habitat destruction would more so impact sharks in tropical areas that depend on structures such as coral reefs (Watling and Norse, 1998).

Finally, the international management and conservation of sharks has largely been unsuccessful (WWF, 2016). There are plenty of international frameworks and documents in place that recommend or dictate how sharks should be managed to conserve populations.

Unfortunately, the frameworks are not followed or are difficult to implement (Techera & Klein, 2011). These frameworks and documents will be discussed in the following chapter.

Recently, within the international realm there has been some progress towards sustaining shark populations; yet, the lack of cooperation between nation-states has made it difficult to achieve certain objectives and goals (Timms and Williams, 2009). This suggests that the international management of sharks in the Northwest Atlantic has not been as successful as one would hope.

4. **Chapter 4** – *International Governance of Sharks*

The migratory nature of sharks (including porbeagle, shortfin mako and blue shark) across different Exclusive Economic Zones (EEZs) and into international waters is what makes them subject to international governance mechanisms. Therefore, the use of domestic management can only do so much. International law and frameworks are there to fill the gaps that national management does not fulfill and to foster international cooperation amongst nation-states, especially when it comes to sharing living resources such as migratory species. Although international management can create common protocols and laws for nation-states and inter-governmental agencies to abide by when it comes to the management of migratory sharks, there

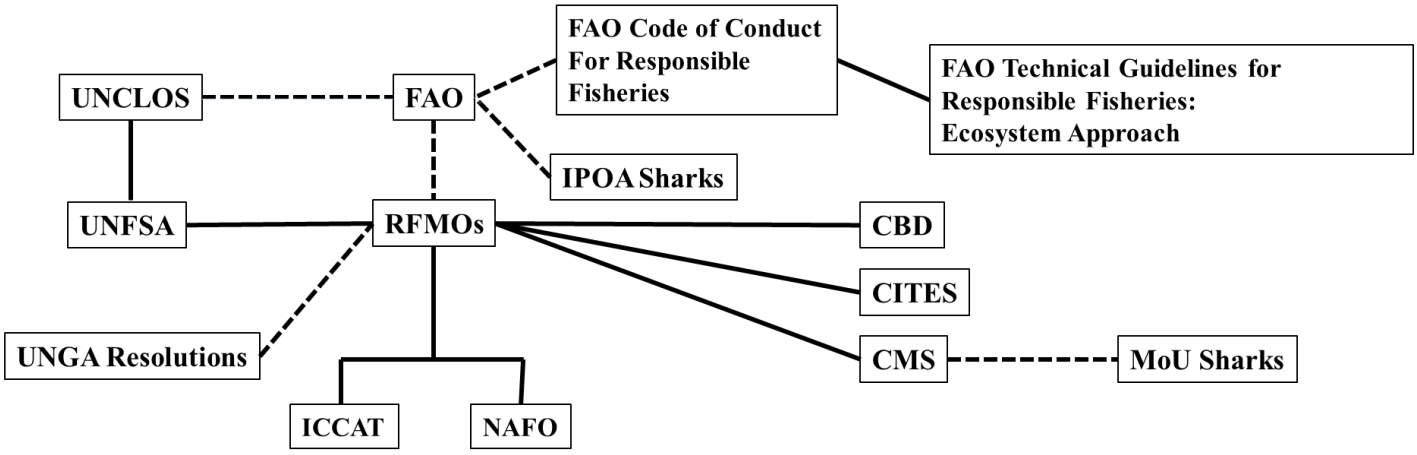


Figure 6: The complex mosaic of international mechanisms that govern international shark management

is not always harmony at the international stage (Osch, 2012). In theory the international governance of sharks is clearly laid out for countries to follow, but in practice the international governance of sharks still exemplifies fragmentation and disharmony (see Figure 6) (Techera, 2011). This chapter will examine the most relevant international frameworks that pertain to the conservation and management of sharks within the high seas such as binding fisheries instruments (hard law), binding non-fisheries instruments/organizations (hard law) and non-binding instruments (soft law).

4.1 Binding Fisheries Instruments

4.1.A United Nations Convention on the Law of the Sea (UNCLOS)

The United Nations Convention on the Law of the Sea (UNCLOS) is a legally binding document that discusses the management of the high seas and its resources. The document came into force in 1994 and currently has 168 parties (Osch, 2012; United Nations Treaty Collection UNCLOS, 2016). UNCLOS recognized EEZs, which allowed for nation-states economic zones to extend to 200 nautical miles. UNCLOS has four overarching broad objectives that apply to the international management and conservation of sharks. The obligations of parties to UNCLOS are:

- Conserve living resources of the high seas;
- Take measures to restore or to maintain populations of harvested species at levels which can produce maximum sustainable yield (MSY);
- Duty for nation-states to cooperate in the management and sharing of living marine resources in the high seas;
- Take into consideration the effects on species associated with or dependent upon harvested species with a view to maintaining and restoring populations of these species (Lack and Sant, 2006).

Although binding, if countries become a party to UNCLOS the conservation and management objectives pertaining to sharks are broad and therefore provide little insight as to how to conserve sharks (Osch, 2012; Techera and Klein, 2010).

4.1.B United Nations Fish Stocks Agreement (UNFSA)

Dissatisfaction with UNCLOS led to The United Nations Fish Stocks Agreement (UNFSA) which was adopted in 1995 and came into force in 2001 (Lack and Sant, 2011; Russell and VanderZwaag, 2010). Currently, there are 83 parties to the UNFSA (United Nations Treaty Collection UNFSA, 2016). The UNFSA reinforces the requirements of UNCLOS and elaborates on how they should be implemented, making the UNFSA more specific than UNCLOS (Lack and Sant, 2006). The UNFSA provides a framework for cooperation in the conservation and management of straddling and highly migratory fish stocks by detailing the minimal international standards for the management of those stocks (Oceans and Law of the Sea United Nations, 2013). Therefore, since most of the agreement focuses specifically on straddling and highly migratory fish within the high seas many of its provisions are relevant to migratory sharks. As with UNCLOS, there are several main principles that have come out of the UNFSA:

- States should manage fish for long-term "sustainable use" based on the best scientific evidence;
- Regional Fishery Management Organizations (RFMOs) have the responsibility to manage straddling and high seas fish stocks, including sharks;
- Allows for more vessel control/monitoring by RFMOs on the high seas.

All three principles applied directly to the conservation and management of sharks. The first principle means that if there is little evidence when managing species then the precautionary approach should be applied. The precautionary approach is defined as the "proposition that when information is uncertain, states must be more cautious in managing stocks (Osch, 2012)." The second principle within the UNFSA describes the framework regarding how RFMOs should function. The framework indicates how species should be managed and gives RFMOs the

responsibility of managing high seas species in order to facilitate cooperation amongst nation-states (Osch, 2012; Techera, 2011; Lack and Sant, 2006). The third principle from the UNFSA gives RFMOs the jurisdiction to increase inspections by port states, flag states and other member states of RFMOs, which can allow for better regulation of certain species and lowers the likelihood of IUU fishing (Osch, 2012). Additionally, within the UNFSA there are other and more specific provisions that can be applied to sharks. For example:

- Where the status of target/non-target stocks is of concern, implement enhanced monitoring of those stocks in order to determine the effectiveness of conservation and management measures (Article 5.e).
- Develop data collection and research programs to assess the impact of fishing on non-target species (Article 5.j) (Lack and Sant, 2006; Lack and Sant, 2011).

Both these provisions relate back to the precautionary approach and have become the responsibility of RFMOs to implement within their contracting parties. However, the UNFSA does create limitations, especially towards RFMO measures. Limitations to RFMO measures include restricted species coverage, non-binding obligations, inconsistent approaches to practices including finning, and the failure to address bycatch problems successfully (Techera, 2011). Therefore, the UNFSA is much more specific than UNCLOS, but still is unable to provide concrete directions for the management and conservation of sharks within the high seas.

Additionally, it can be argued that both UNCLOS and the UNFSA include certain aspects of the ecosystem approach. The approach is not specifically referred to within the agreements but they both acknowledge certain aspects of the principle such as long-term sustainability, cooperation and the protection of endangered species (Pinto, 2012; Russell and VanderZwaag, 2010a).

4.2 Binding non-fisheries instruments/organizations

4.2.A Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES)

The Convention on the International Trade in Endangered Species of Wild Flora and Fauna or otherwise known as CITES is an intergovernmental treaty that regulates the international trade of endangered and threatened species. With 175 contracting parties, CITES is able to enforce restrictions on the trade of endangered or threatened species by requiring import and export permits (Pew Environment Group, 2013). CITES operates by listing species on one of three different appendices and depending on which appendix a species is on member states incur particular international obligations. The parties that have ratified CITES decide what appendix a species should be placed on. Each appendix offers a different level of protection. Appendix I lists species that are most endangered. CITES prohibits international trade in species listed under Appendix I except when the purpose of the import is not commercial (e.g. for scientific research. In certain circumstances trade may take place of a species listed on Appendix I but, it can only occur when it is authorized by the granting of both an import and export permit. Appendix II lists species that may not necessarily be currently threatened with extinction but may be in the future unless trade of the species is closely controlled. International trade of species listed on Appendix II is possible but may only be authorized by the granting of an export permit or re-export certificate. No import permit is needed for species listed on CITES Appendix II. Permits and certificates are only granted if certain conditions are satisfied and if the trade of the species will not be detrimental to the survival of the species in the wild. Appendix III is a list of species included at the request of a party that already regulates trade in the species and needs cooperation amongst nation-states to prevent the unsustainable or illegal exploitation of the species.

International trade of a species under Appendix III is allowed but only with the proper permits or certificates (CITES, 2016).

Some well-known shark species are on the CITES Appendices such as great whites and whale sharks but lesser known shark species have received little attention (e.g. Porbeagle). Currently, three shark species are recognized under Appendix I and five have only recently been placed on Appendix II. Porbeagle is the only Northwest Atlantic shark species that can found on a CITES Appendix (Appendix II), making the number of protected sharks species by CITES in the Northwest Atlantic extremely low (CITES, 2016; Sharks & Manta Rays, CITES, n.d.).

The issue with letting the contracting parties decide if a species should be placed on an appendix is that a party can repeatedly block attempts to place species on one of the appendices should it so wish. This failure is illustrated in the attempt to place porbeagle on CITES Appendix II since 2009. Contracting parties continuously blocked other contracting parties' efforts to protect porbeagle (Lack and Sant, 2011). Therefore, securing shark conservation through an appendix listing is perhaps not the most effective way for shark conservation and management within the high seas (Osch, 2012).

4.2.B Convention on the Conservation of Migratory Species of Wildlife (CMS)

The Convention on the Conservation of Migratory Species of Wildlife (CMS) is similar to CITES in the way that it lists species on two different appendices depending on their conservation status. There are currently 124 contracting parties to CMS (CMS, 2016). Depending on the status of a migratory species, parties to CMS can take different actions to protect the species. Appendix I includes species that have been assessed as being in danger of extinction throughout all or a large portion of their range. Parties that are a range State to a

migratory species listed on Appendix I shall attempt to protect the species by: "prohibiting the taking of such species; conserving and restoring their habitats; prevent, remove or mitigate obstacles to a species migration and control other factors that might endanger the species (CMS, 2016)." Appendix II covers migratory species that have an unfavourable conservation status and that require international cooperation and agreements for their conservation. The Convention encourages the range states to create global or regional agreements for the conservation and management of migratory species listed on Appendix II. This can be completed using different instruments such as Memoranda of Understanding, Action Plans or Species Initiatives (CMS, 2016). There are currently only thirteen shark species listed under the CMS Appendices (see Table 1), with only two species listed under Appendix I (CMS Species, 2016). This indicates there is little protection for migratory shark species.

Name	Year	Appendix
Pelagic Thresher Shark	2014	II
Big Eye Thresher Shark	2014	II
Common Thresher Shark	2014	II
Narrow Sawfish	2014	I
Silky Shark	2014	II
Great White Shark	2002	I
Basking Shark	2005	I
Shortfin Mako	2008	II
Longfin Mako	2008	II
Porbeagle	2008	II
Whale Shark	1999	II
Scalloped hammerhead Shark	2014	II
Great hammerhead Shark	2014	II

Table 1: Shark species listed under the CMS Appendices

CMS, like CITES, provide the only 'hard law' obligations to protect sharks within the high seas. However, the scope of operation is limited and protections are only implemented for a few shark species (Techera and Klein, 2010). The treaties are not focused on the use of species but on their preservation and are only invoked when a species is close to extinction. This calls to question whether there should be more preventative measures to protect sharks and other species rather than just retrograde protections (Osch, 2012)

4.2.B (i) Memorandum of Understanding on Sharks (MoU Sharks)

The Memorandum of Understanding on Sharks or from here on known as the MoU was created in 2010 under the auspices of the CMS (Osch, 2012). The MoU currently has 39 parties and is voluntary, meaning nation-states do not need to become signatories if they wish not to do so (CMS Secretariat, 2015). Additionally, the MoU has listed 29 different species of sharks and rays that are of particular importance for protection (see Figure 7). Both porbeagle and shortfin mako are listed within the MoU; however, blue sharks are still not listed (CMS, 2015). The MoU focuses on increasing international cooperation between all relevant international organizations and stakeholders (e.g. FAO, RFMOs, etc.) to specifically protect migratory sharks (Pew Environment Group, 2013; Osch, 2012). Listed in Annex III of the MoU are the principles of its Conservation Plan for sharks. The principles include:

Figure 7: Shark species listed on Annex I of the MoU Sharks

Basking Shark (*Cetorhinus maximus)*
Great White Shark (*Carcharodon carcharisas)*
Longfin Mako Shark (*Isurus paucus)*
Porbeagle (*Lamna nasus)*
Shortfin Mako Shark (*Isurus oxyrinchus)*
Spiny Dogfish (*Squalus acanthias)*
Whale Shark (*Rhincodon typus)*
Silky Shark (*Carcharhinus falciformis)*
Great Hammerhead Shark (*Sphyrna mokarran)*
Scalloped Hammerhead Shark (*Sphyrna lewini)*
Thresher Sharks *(Alopia supercilliosus)* *(Alopias vulpinus)* *(Alopias pelagicus)*
Giant Manta Ray (*Manta birostris)*
Reef Manta Ray (*Manta alfredi)*
Sawfishes *(Anoxypristis cuspidata)* *(Pristis clavata)* *(Pristis prectinata)* *(Pristis pristis)*
Mobula Rays ***(Mobula mobular)*** ***(Mobula japonica)*** ***(Mobula thurstoni)*** ***(Mobula tarapacana)*** ***(Mobula eregoodootenkee)*** ***(Mobula kuhlii)*** ***(Mobula hypostoma)*** ***(Mobula rochebrunei)*** *(Mobula munkiana)*

- The Conservation Plan applies exclusively to those migratory species of sharks included in Annex 1 of the Memorandum of Understanding. Depending on the occurrence of a species, Signatories may set species-specific priorities.
- The Conservation Plan aims to complement, develop and promote the objectives and actions described in this Memorandum of Understanding to conserve and manage migratory sharks and their habitat. In particular, it

establishes a comprehensive list of actions to further the objectives and actions of Section 4 of this Memorandum of Understanding.

- The objectives and related activities within the annexes of the MoU should be implemented by Signatories either individually or cooperatively or both, as appropriate, including through:
    - Participation in and cooperation with the Food and Agriculture Organization of the United Nations (FAO) and, as appropriate, Regional Fisheries Management Organizations (RFMOs), Regional Seas Conventions and Action Plans (RSCAPs), and other relevant biodiversity-related MEAs;
    - Establishment of regional, sub-regional and any other cooperative arrangements considered by the Signatories to be necessary;
    - Cooperation with the Secretariat.
- Signatories should, periodically evaluate the effectiveness of efforts and strategies to implement this plan, with the technical and scientific support of the Secretariat and the Advisory Committee, as well as consider revisions or amendments if necessary to strengthen its effectiveness or applicability, consistent with Section 6 of this Memorandum of Understanding.
- Signatories endeavour to create synergies amongst their respective national and regional administrations responsible for environmental and fisheries-related policies as they affect sharks so as to facilitate the universal implementation of the contents of the Conservation Plan into their governmental programmes
- Signatories are encouraged to prioritize implementation of these actions with highest scores for priority.

- Signatories are encouraged to use this Conservation Plan, as whole or only parts of it, and translate it into national or regional actions.
- The Conservation Plan combines short-term and long-term activities (CMS, 2016).

The MoU Sharks is a unique document because not only does it lay out the main principles of how migratory sharks should be protected and managed, it offers different objectives for nation-states and organizations. The annexes of the MoU provide detailed descriptions of how to:

  - Improve the understanding of migratory shark populations through research monitoring and information exchange;
  - Ensure that directed and non-directed fisheries for sharks are sustainable;
  - Ensure to the extent practicable the protection of critical habitats and migratory corridors and critical life stages of sharks;
  - Increase public awareness of threats to sharks and their habitats, and enhance public participation in conservation activities;
  - Enhance national, regional and international cooperation (CMS, 2015).

On top of the main principles and objectives, the MoU provides complete descriptions of actions that can be taken by nation-states to ensure the principles and objectives of the MoU are fulfilled. Some examples of actions that can be pursued include: developing certification systems for sustainable shark products, avoiding the mortality of juvenile sharks, increasing the knowledge of the ecosystem services provided by sharks and where possible, cooperate in establishing transboundary marine protected areas using ecological rather than political boundaries. A full list of the actions, their priority, and a timeline for when they should be completed can be found in the annexes of the MoU-Sharks (CMS, 2016). Furthermore, not only

does the MoU discuss how to acquire successful management for migratory sharks, the MoU encompasses and advocates for the use of the precautionary approach and the ecosystem approach towards international shark management and conservation (Techera, 2011).

4.2.C Convention on Biological Diversity (CBD)

The Convention on Biological Diversity (CBD) came into force in 1993 and currently has 196 parties. The CBD has three main objectives: the conservation of biodiversity, the sustainable use of its components, and fair and equitable sharing of benefits arising from resources. All three objectives influence the conservation and management of sharks in the Northwest Atlantic because the convention obliges member states to protect the biodiversity/sustainability of sharks within their national jurisdiction and when subjected to activities out of their national control (Osch, 2012). Furthermore, the CBD advocates for an ecosystem approach, precautionary approach and adaptive management schemes when managing species. This is particularly true under Target 6 of the 20 Aichi Biodiversity Targets. In 2011 under the CBD, contracting parties established the Strategic Plan for Biodiversity 2011-2020 that encompasses the 20 Aichi Biodiversity Targets. Target 6 pertains specifically to sharks because it calls for nation-states by 2020 to manage and harvest fish stocks legally, sustainably and through the ecosystem approach (United Nations Environment Programme, n.d.). The proper management of migratory sharks within countries' EEZs creates a starting point for healthy shark populations within the high seas (Techera and Klein, 2010).

The weakness of the CBD lies in the soft language used in the Convention's provisions. As with other international documents, such as UNCLOS, the broad provisions do not establish concrete obligations on behalf of the states, making the CBD ineffective at successfully managing shark populations (Techera and Klein, 2010).

4.3 Non-binding instruments (soft law)

4.3.A 1995 FAO Code of Conduct for Responsible Fisheries

The 1995 FAO Code of Conduct for Responsible Fisheries is a voluntary and a non-binding document created by the FAO in 1995 to establish principles and standards of behaviour for responsible fisheries within both domestic waters and the high seas. In 1995 more than 170 Members of the Food and Agriculture Organization of the United Nations adopted the Code. Within the Code of Conduct (Article 6) there are nine general principles that create the foundation for what responsible fisheries entail. The nine general principles call for: increased research, cooperation amongst nation-states, trade requirements, the application of the precautionary and ecosystem approaches and integrated fisheries management (Fisheries and Aquaculture Development, 2001; Fischer et al., 2012). In particular, the Code calls for improved regional and international cooperation towards fisheries management by stating that management measures taken by one nation-state should be compatible with similar measures adopted by other nation-states. Furthermore, regional management organizations, such as RFMOs are important mechanisms for creating universal and compatible management measures (FAO, 1995). The 1995 FAO Code of Conduct directly relates to sharks because it provides an outline regarding how sharks should be managed by nations and RFMOs within the high seas and it directly emphasises similar principles and objectives that are found within the MoU Sharks and the CBD.

4.3.B FAO Technical Guidelines for Responsible Fisheries: The Ecosystem Approach

From the 1995 FAO Code of Conduct for Responsible Fisheries the FAO created the FAO Technical Guidelines for Responsible Fisheries: The Ecosystem Approach, along with twenty other FAO Technical Guidelines for Responsible Fisheries (Russell and VanderZwaag, 2010b). The document goes into great detail to discuss and outline the main components of the

ecosystem approach and how they should be applied within fisheries management. The main principles and concepts in the FAO Technical Guidelines for Responsible Fisheries: The Ecosystem Approach include:

- Fisheries should be managed to limit their impact on the ecosystem to the extent possible;
- Ecological relationships between harvested, dependent and associated species should be maintained;
- Take into account species interactions and the interdependence of stocks;
- Management measures should be compatible across the entire distribution of the resource (across jurisdictions and management plans);
- The precautionary approach should be applied because the knowledge on ecosystems is incomplete;
- Governance should ensure both human and ecosystem well-being and equity;
- Ensure reversibility and construct rebuilding plans for species if necessary;
- Broaden stakeholder participation (FAO, 2008).

Building on the main concepts outlined above the document provides different methods on how the ecosystem approach towards fisheries can be applied (e.g. gear selectivity, catch controls, habitat modification), incentives for nation-states to apply the approach and even identifies threats to the successful implementation of the approach (FAO, 2008). In doing so, the FAO provides a comprehensive document regarding the ecosystem approach towards fisheries. Furthermore, the FAO has created an integral framework for nation-states and international agencies to aide in the application the approach (FAO, 2008). Therefore, this framework is relevant to the international management of sharks because other frameworks such as the CBD

call for the application of the approach towards sharks but do not explicitly state how it should be applied.

4.3.C International Plan of Action (IPOA – Sharks)

The International Plan of Action or IPOA-Sharks was developed within the FAO following a request from the FAO Committee on Fisheries (COFI). The IPOA-Sharks was created and endorsed in 1999. The IPOA calls upon states to create National Plans of Actions (NPOAs) and Regional Plans of Actions (RPOAs) for the conservation and management of sharks. Within the IPOA are ten main principles and recommendations of how sharks should be managed (see Appendix 3). Furthermore, the IPOA discusses the ecosystem and precautionary approach and covers both target and bycatch species (Techera and Klein, 2010; Lack and Sant, 2011). The IPOA-Sharks appears to be the harmonizing framework that will encourage nation-states to work cooperatively to conserve shark populations.

The IPOA-Sharks has had extremely slow implementation by nation-states, meaning many countries have not created their own NPOAs (Fischer et al., 2012). Furthermore, the IPOA-Sharks will only be effective if the top shark fishing nation-states have an NPOA because the top twenty shark fishing nation-states account for nearly eighty percent of the total reported shark catch. At least seven of the top twenty shark fishing states fish within the Northwest Atlantic (US, UK, Spain, France, Portugal, Japan and South Korea). However, only thirteen of the top twenty have NPOAs (Lack and Sant, 2006; Lack and Sant, 2011). Additionally, only seven RPOAs have been adopted worldwide (FAO National and Regional Plans of Action, 2016). Lastly, the IPOA does not create binding rights and obligations on states and acts merely as a framework (Techera and Klein, 2010), making the IPOA not as successful as the FAO would have hoped.

4.3.D United Nations General Assembly (UNGA) Resolutions

The United Nations General Assembly (UNGA) recognizing the importance and the need to conserve ocean resources, adopts sustainable fisheries resolutions in attempts to pressure and encourage states and RFMOs to improve their management efforts. However, the efforts of the UNGA sometimes gain little attention because RFMOs have been slow or ineffective at implementing the called for resolutions (Gjerde et al., 2013; United Nations A/RES/62/177; United Nations A/RES/65/38; United Nations A/RES/69/292; United Nations A/RES/70/75) (see Figure 8). At times UNGA Resolutions have been influential and have the opportunity to be successful in the future (Osch, 2012). For example, UNGA RES 69/292 will hopefully lead to a legally binding instrument that can protect species located within the high seas (United Nations A/RES/69/292). If RES 69/292 is successful it may allow for the creation of marine protected areas (MPAs) within the high seas that will allow for the conservation and protection of highly migratory shark species. Furthermore, since 2006 UNGA resolutions have identified and

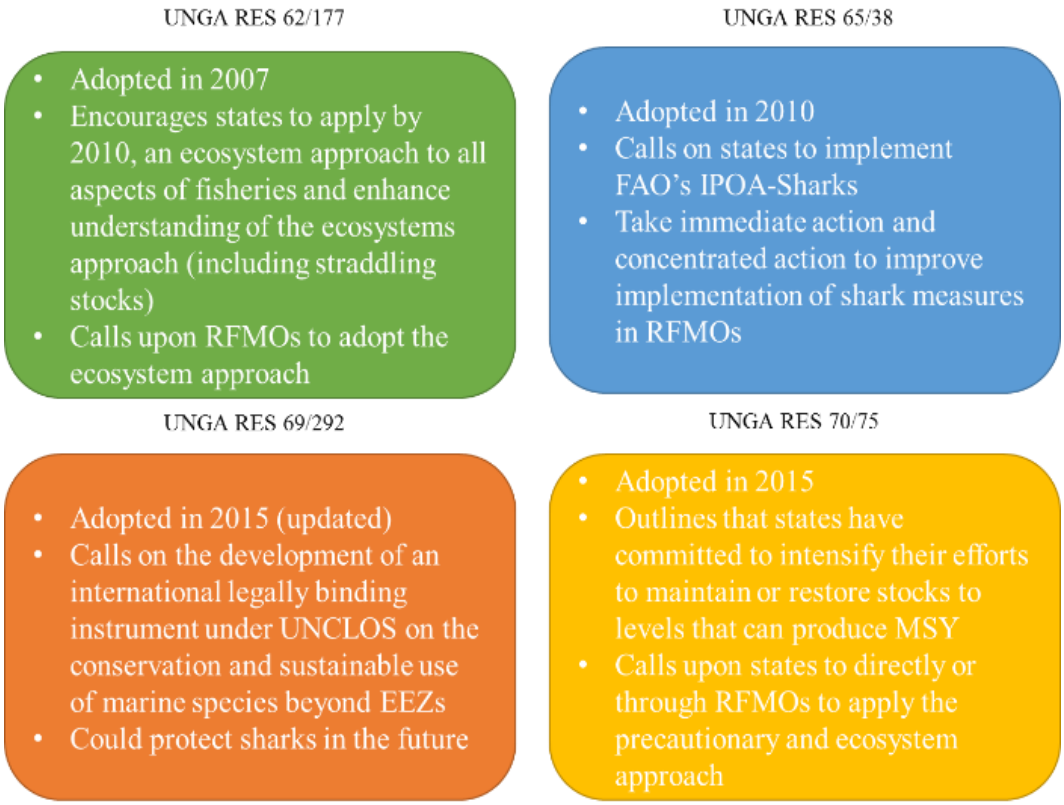


Figure 8: UNGA Resolutions concerning sharks

continuously called upon nation-states and RFMOs for the need to abolish the negative 5% fin-weight-ratio and replace it with the 'fins naturally attached' policy (A/RES/60/31, 2006). This indicates that UNGA resolutions can be helpful at bringing international attention to certain migratory shark issues such as finning or the lack of nation-states adopting the IPOA sharks but otherwise, UNGA resolutions have minimal impacts on the conservation of shark populations.

The complex mosaic of international laws, treaties and frameworks that attempt to conserve and manage sharks are full of fragmentation and disharmony, making them largely unsuccessful (Russell and VanderZwaag, 2010b). Additionally, because of a lack of resources countries struggle to properly implement new international resolutions, obligations and laws (Techera and Klein, 2010). However as the international documents surrounding shark conservation and management have evolved from the early 1990s, one can see the emergence of principles such as the ecosystem and precautionary approach. The ecosystem approach should and must play an important role in managing shark populations if humankind is to conserve sharks within the Northwest Atlantic (Engler, 2015).

5. Chapter 5 – *The Ecosystem Approach in the International Management of Sharks in the Northwest Atlantic*

5.1 The Ecosystem Approach

The ecosystem approach is a relatively new approach within international environmental and fisheries law. The approach began to evolve in the early 1980s and is now widely used within different international laws and frameworks (FAO, 2008). There are multiple definitions of what the ecosystem approach entails. The Fisheries Code of Conduct describes the ecosystem approach as "the integrated management of water and land that promotes conservation and sustainable use of resources in an equitable way (FAO, 1995)." The CBD has a more specific definition but simply outlines that the ecosystem approach will help reach the three CBD objectives of: biodiversity protection, sustainable use of resources and the equitable sharing of resources (CBD Secretariat, 2016). Additionally, the ecosystem approach has its own definition for when applied directly to fisheries.

> "The Ecosystem Approach to Fisheries (EAF) strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties of biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries (FAO, 1995)."

The literature further describes how the complexity of ecosystems cannot be totally understood by science at present (Russell and VanderZwaag, 2010a). However, management decisions need to be made using the data available and therefore, if the data is not available one must use the precautionary approach (FAO, 2008). Additionally, the ecosystem approach requires adaptive management to deal with the complex and dynamic nature of ecosystems in the absence of complete knowledge or understanding of their functioning. Ecosystem processes are non-linear which leads to uncertainty; therefore, the management plans must be adaptive (CBD, 2016b). Both the precautionary approach and adaptive management framework are closely

connected to the ecosystem approach and some authors consider the two principles to be a component of, or are mandated by the other (Engler, 2015).

There is still confusion surrounding what exactly is the ecosystem approach and how it should be applied; however, after surveying the literature, Engler provided the most universally accepted agreements on what the ecosystem approach entails (2015). The below points account for what this project and Engler believes the ecosystem approach requires.

1. The ecosystem approach is a holistic or systems approach;
2. Humans are a part of nature;
3. Place-based management with ecologically defined boundaries;
4. Management should be decentralized to the lowest appropriate level;
5. Management should be based on collaborative decision making;
6. Management should focus on the long term;
7. The ecosystem approach is knowledge-based;
8. Is prepared for dealing with uncertainties.

5.2 Issues with the Ecosystem Approach

Although a long list of possible issues with the ecosystem approach could be discussed and debated, here only a few will be touched upon. Much of the confusion surrounding the ecosystem approach has to do with a lack of universal definition. Having no universal definition makes it difficult for countries to properly implement the ecosystem approach when managing sharks. There are many terminological nuances within the literature surrounding the approach. For example, some authors use the terms ecosystem management and ecosystem approach interchangeably, while others draw distinctions between the two terms. Not only can the approach be confusing, it can be difficult to implement (Russell and VanderZwaag, 2010a). Finally, there are issues with creating, selecting and using indicators to evaluate ecosystems (Engler, 2015). However, the existence of all the issues with the ecosystem approach does not

mean that it is a failure or that nation-states and international bodies should not strive to achieve this approach.

5.3 Importance of the Ecosystem Approach

The importance of the ecosystem approach is that if it is successfully implemented it can maintain biodiversity, create cooperation amongst nations and allow for long term sustainability of ecosystems. This is why the approach is widely accepted and advocated for by academics, scientists and marine managers (Simons, & von Menffont, 2015). In the absence of an ecosystem approach, sharks as well as other species have been governed on an individual species basis, there were narrowly focused scientific monitoring programs, there was a lack of scientific understanding, there were single use and purpose observations, and species were observed using only narrow perspectives and scale (Shewchuk, n.d.). These methods have been proven to be unsuccessful for sustainable management which is why one sees the ecosystem approach appearing in many international frameworks (e.g. MoU, CBD, IPOA-Sharks, UNGA Resolutions, Code of Conduct, etc.) (Russell and VanderZwaag, 2010a; Techera, 2011; Simons & van Menffont, 2015). If sharks are to be conserved and properly managed within the Northwest Atlantic the ecosystem approach needs to be applied, not only by states but by the RFMOs that have convention areas and jurisdictions within the high seas in the Northwest Atlantic. Otherwise, shark populations may continue to decline.

6. Chapter 6 – *Regional Fisheries Management Organizations*

6.1 RFMOs

Currently, under international law nation-states are required to cooperate at managing the resources located within the high seas (Fisheries and Oceans, 2011). Regional Fisheries Management Organizations or RFMOs are the institutions responsible for managing fish stocks within the high seas and are a platform for nation-states to work cooperatively. RFMOs came into existence roughly a hundred years ago because there was no cooperation amongst nation-states fishing common transboundary stocks (EU, 2015). Since then, different types of RFMOs have been established. For example, there are tuna RFMOs, ground-fish RFMOs, salmon RFMOs and others. Additionally, each RFMO has a different size convention area that may or may not overlap with multiple nation-states' EEZ's or with another RFMO's convention area. A nation-state becomes a part of an RFMO by becoming a contracting party (CP). Depending on a nation-state's historical presence in a RFMOs convention area or nation-states' proximity to a RFMO's convention area, a nation-state can become a contracting party to an RFMO. The CPs help establish quotas, fishing closures, bycatch restrictions, gear restrictions and other regulations. Furthermore, within RFMOs there are specific councils and groups that are dedicated to executing certain tasks (e.g. Scientific Council or a Bycatch Reduction Committee) (Lodge, 2008).

Although in 1995 the UNFSA gave RFMOs the binding responsibility to manage and conserve straddling and highly migratory fish stocks in the high seas[2], it appears that RFMOs have not been successful at managing and conserving high seas species. This is clear because

[2] Which recently includes managing bycatch, non-target species and areas of importance for ecosystems (Techera, 2011).

over two-thirds of fish stocks within the high seas are over-exploited (Cullis-Suzuki and Pauly, 2010; Techera, 2011). Implementation of shark management measures has been slow and quotas have been ignored. There has been a lack of compliance and cooperation by nation-states and foreign vessels and a lack of science to make proper decisions has hindered RFMOs from successfully being able to complete their mandates (Cullis-Suzuki and Pauly, 2010; Mooney-Seus and Rosenberg, 2007; Szigeti and Lugten, 2015). Furthermore, as coastal stocks become more depleted there is a larger demand for more nations to start fishing within the high seas (Cullis-Suzuki and Pauly, 2010). This is where the ecosystem approach should become a dominating principle in how RFMOs manage ecosystems and species. Not only because of the success the ecosystem approach could bring, but because the ecosystem approach has been mentioned in and has been called for in international law multiple times within the last two decades (A/RES/62/177; CBD, 2016a; FAO, 2008). Therefore, this project evaluated whether or not the two shark-related RFMOs in the Northwest Atlantic have been applying the ecosystem approach when it comes to managing and conserving Northwest Atlantic shark species. First, the shark measures within each RFMO have to be examined.

6.2 ICCAT (see Appendix 4 for general information on ICCAT)

6.2.A Measures that govern sharks

ICCAT is viewed as the main shark-related RFMO within the Northwest Atlantic and therefore, has numerous resolutions to conserve and manage sharks. Resolution 15-11 calls for the ecosystem approach when it comes to managing sharks. Resolution 15-11 states that whenever making recommendations ICCAT should take into consideration the ecosystem approach, minimize the negative impacts that fishing and human activities can have on the marine environment and take a holistic approach to managing ecosystems (ICCAT 15-11, 2015).

Additionally, under Resolution 03-10 ICCAT has resolved that each CP should fully implement the NPOA-Sharks (Fischer et al., 2012). Under RES 04-10 in 2005 ICCAT adopted nine overarching shark management measures:

1) CPs and CPCs (contracting parties to the convention), shall annually report Task I and Task II data for catches of sharks, in accordance with ICCAT data report procedures, including available historic data.
2) CPCs shall take the necessary measures to require all fisherman fully utilize their entire catches of sharks except for head, guts and skin.
3) Contracting Parties (CPs) shall require their vessels not to have onboard shark fins that total more than 5% of the weight of sharks onboard, up to the first point of landing. CPs that currently do not require fins and carcasses to be offloaded together at the point of first landing shall take the necessary measures to ensure compliance with the 5% fin-to-body weight ratio through certification, monitoring by an observer, or other appropriate measures.
4) Fin-to-body weight ratio of sharks will be reviewed and reported back to the Commissions in 2005.
5) Fishing vessels are prohibited from retaining on board, transhipping or landing any fins harvested in contravention to this record.
6) In fisheries that are not directed at sharks, CPCs shall encourage the release of live sharks, especially juveniles.
7) CPCs shall, where possible, undertake research to identify ways to make fishing gears more selective.
8) CPCs shall, where possible, conduct research to identify shark nursery areas.
9) The Commission shall consider appropriate assistance to developing CPCs for the collection of data on their shark catches.

Additionally, after 2005 ICCAT adopted other measures to improve shark management. RES 15-02 called on CPCs to only use non-entangling FADS[3] by 2016 and for CPCs to report on an annual basis to the ICCAT Secretariat regarding the steps undertook to complete this process. RES 03-10 and RES 12-05 called on CPCs to improve data reporting by annually reporting all shark data (e.g. shark catches, effort by gear type, landings and trade products) to ICCAT and by submitting the details of how they have implemented the other adopted shark conservation and management measures (RES 04-10, 07-06, 09-07, 10-08, 10-07, 11-08 and 11-15). Furthermore,

[3] FADs or otherwise known as Fishing Aggregate Devices are floating devices such as buoys used to attract fish.

RES 13-10 explains the protocol for when CPCs can collect scientific samples from sharks (COFA TUNAS, 2015). For example, biological samples of prohibited sharks can only be collected from animals which are dead at the haul back. The Standing Committee on Research and Statistics (SCRS) must be notified of the sample, the biological sample must remain on board the vessel until the port of landing or transhipment and the biological sampling campaign can only start once authorisation by the relevant State has been issued (COFA TUNAS, 2015)

6.2.B Independent measures for specific shark species

Although ICCAT has completed stock assessments for the blue shark, shortfin mako and porbeagle and conducts new assessments of each stock roughly every five years, ICCAT has only been able to implement specific restrictions for shortfin mako and porbeagle. RES 10-06 dictated that CPCs that do not report catch data of shortfin mako will be prohibited from retaining the species. However, this measure can be argued as being weak because many ships were reporting all data beforehand. Furthermore, at the latest ICCAT meeting the CPCs agreed to act to help porbeagle populations by adopting RES 15-06 (COFA TUNAS, 2015). The measure that was passed banned the retention of porbeagle, required the release of live porbeagle (if caught) and if the number of porbeagle increased from 2014 levels additional measures to limit catch could be implemented or enforced, such as a complete prohibition on shortfin mako (Schleit, 2015). There are no specific measures concerning blue sharks.

Even though there are relatively weak measures for the three listed sharks there are strong measures for other sharks. Thresher sharks, whitetip sharks, hammerhead sharks and silky sharks all have specific protection measures. The protection measures include fishing prohibitions, certain restrictions on particular gears that attract shark species of concern, and a call for

improved research surrounding the species. These measures could help increase porbeagle, shortfin mako and blue shark numbers if adopted (COFA TUNAS, 2015).

6.3 NAFO (See Appendix 4 for general information on NAFO)

6.3.A Measures that govern sharks

All NAFO shark measures are located within Article 12 of NAFO's Conservation and Enforcement Measures. Within Article 12 there are only seven measures that pertain directly to sharks (NAFO, 2016). The responsibility to manage sharks within NAFO's Convention area is not as important as within ICCAT because sharks are more likely to be caught due to long-line fisheries, which are much more prominent within ICCAT than NAFO. This is why many tuna and tuna-related RFMOs have taken on the role of managing shark species (PEW Environment Group, 2013). Although, this does not mean NAFO should have no measures to manage and conserve sharks because of issues concerning bycatch. NAFO in its amended Convention calls for the ecosystem approach when managing species. Once NAFO ratifies their adopted Convention by at least a three-fourths majority of their CPs, NAFO will hopefully be better equipped to effectively enforce the ecosystem approach[4] (NAFO Introduction, n.d.). For example, the application of the ecosystem approach by NAFO includes safeguarding the marine environment, conserving its marine biodiversity, minimizing the risk of long term or irreversible adverse effects of fishing activities, and taking account of the relationship between all components of the ecosystem (NAFO STACTIC, 2015). Therefore, the application of the ecosystem approach may have direct positive impacts on sharks. The current seven shark measures within NAFO are as follows:

[4] As of September 2014, six Contracting Parties have ratified the amended Convention (NAFO Introduction, n.d.).

1) Contracting Parties shall report all catches of sharks, including available historical data, in accordance with the data reporting procedures set out in Article 28.
2) Up to the point of offloading, no fishing vessel shall discard any part of shark retained on board except the head, guts or skin.
3) Contracting Parties (CPs) shall require their vessels not to have onboard shark fins that total more than 5% of the weight of sharks onboard, up to the first point of landing. CPs that currently do not require fins and carcasses to be offloaded together at the point of first landing shall take the necessary measures to ensure compliance with the 5% fin-to-body weight ratio through certification, monitoring by an observer, or other appropriate measures.
4) No fishing vessel shall retain on board, tranship or land any fins harvested in contravention of these provisions.
5) In fisheries that are not directed at sharks, each CP shall encourage every vessel entitled to fly its flag to release live sharks, especially juveniles that are not intended for use as food or subsistence.
6) CPs shall, where possible, undertake research to identify ways to make fishing more selective for the protection of sharks.
7) CPs shall when possible conduct research to identify shark nursery areas (NAFO, 2016).

Recently, the European Union (EU) and the United States tabled a joint proposal to strengthen current shark management measures in Article 12. Both the EU and United States want to eliminate the 5% fin-to-body weight ratio by adopting no shark finning on vessels. This is known as the 'fins-attached' policy. The 5% fin-to-body weight ratio requires that vessels not have on board shark fins that total more than 5% of the weight of sharks on board. The ratio was created to limit the amount of shark finning although; it is highly opposed and unsuccessful at limiting the amount of shark finning (Cortez and Neer, 2006). In order to amend the 5% fin-to-body weight ratio there needs to be a three-fourths majority (NAFO, 2004). The EU and the United States did not reach the three-fourths majority at the September 2015 General Council meeting because other large countries, such as Japan and Canada, were able to block the proposed amendment (Schleit, 2015). Furthermore, NAFO has closed fishing areas to bottom trawling to protect deep sea corals but has not adopted closed areas for sharks (NAFO STATIC, 2015).

6.3.B Independent measures for specific shark species

There are no measures that specifically target porbeagle, shortfin mako or blue shark populations within NAFO. However, there are other protective measures that target deep water corals and thorny skates (NAFO, 2016).

6.4 Current Shark Management Practices

ICCAT and NAFO share many of the same shark measures, which is true for several other RFMOs (COFA TUNAS, 2015; NAFO, 2016). Since several RFMOs have similar shark measures there have been many critiques from academics and managers regarding the current shark measures in place (Dent and Clarke, 2015).

The first problem is the slow nature of RFMOs to implement change. For example, there have been multiple proclamations and resolutions by the UNGA for RFMOs to call on CPs to institute their own NPOA-Sharks (Davis and Worm, 2013). However, several RFMOs have still not acted (Dent and Clarke, 2015; NAFO, 2016). Additionally, RFMOs have been slow at implementing prohibitions on certain shark species needing protection (Davidson et al., 2016). For example, NAFO has no prohibitions on any shark species while ICCAT only has prohibitions on porbeagle, thresher sharks, whitetip sharks, hammerhead sharks and silky sharks; with no prohibitions for blue, or shortfin mako sharks (COFA TUNAS, 2015).

The second problem with shark measures within RFMOs is that principles such as the precautionary and ecosystem approach need to be applied when necessary data is not present to ensure the sustainability of shark species. Currently, there is a lack of data on shark populations and shark catch. Many of the quotas and catch measures in place lack the proper foundation to make acceptable management decisions. For example, the available FAO data on global shark

catch underestimates actual mortality considerably since they do not include shark discards (Anderson, 2011; Levesque, 2008). Estimates of global shark catch for the shark fin trade indicate that shark landings in the fin trade alone is 3-4 times high than the total shark catch reported by the FAO. Additionally, shark catch is usually not reported by species, eliminating the chance of accurately reporting the correct shark species (Lack and Sant, 2006). Therefore, within ICCAT and other RFMOs there is a lack of reporting and available scientific data, making it difficult to determine how each shark species should be managed (Schleit, 2015).

However, the main problem and perhaps the easiest to fix is ICCAT's and NAFO's shark 'finning ratio'. Aforementioned, shark finning is one of the main concerns for shark conservation (Spiegel, 2001). Therefore, it is important to have proper measures in place to ensure that sustainable finning is possible. However, current measures for international shark management in the Northwest Atlantic are not effective (Worm et al., 2013). NAFO and ICCAT have the same finning measure: not to have a mass of shark fins that total more than 5% of the weight of sharks onboard, up to the first point of landing (COFA TUNAS, 2015; NAFO, 2016). But, there are many problems with the 5% fin-weight ratio. The measure does not specify whether the fins should be wet fins or dry fins. There is a big difference in weight between something that is wet or dry (Biery and Pauly, 2012). Furthermore, the fin ratio between species, the choices of fin set, finning procedure and the state of the shark carcass (dressed or round) varies between species and vessel (Godin and Worm, 2010). Therefore, RFMOs cannot have one overarching measure that is effective for all shark species because each shark species and fishery is different. Furthermore, finning is a wasteful practice that only uses 2-5% of the entire shark (Godin and Worm, 2010). There are certain loopholes that emanate from the 5% finning ratio such as illegal finning, high grading (mixing carcass and fins from different species) or retaining more fins for

every carcass on board (Godin and Worm, 2010; Schleit, 2015). The solution to the 5% shark finning ratio is to establish a 'fins attached' policy where no shark can be finned until a ship has reached a port (Biery and Pauly, 2012; Godin, Worm, 2010). Although, carrying entire sharks on ships would limit the amount of space, there seems to be no other viable option to address this issue globally (Biery and Pauly, 2012).

RFMOs to the best of their ability have attempted to live up to international agreements and standards but are struggling at preventing unsustainable fishing (Gjerde et al., 2013). The evidence suggests this is particularly true in the ways that NAFO and ICCAT manage shark species. If shark management were successful scientists would not be seeing continuous declines in porbeagle, shortfin mako and blue shark populations in the Northwest Atlantic. This project believes, along with other academics, that if the ecosystem approach can be applied within NAFO and ICCAT many of the issues surrounding shark management would not exist (Mooney-Seus and Rosenburg, 2007). Therefore, this project will examine whether or not the ecosystem approach has been applied by NAFO and ICCAT towards international shark management.

7. Chapter 7 – *Methodology*

The methodology for this project is as follows:

I. After a **preliminary literature review** from online sources this project was able to determine that international shark management had not been very successful in the Northwest Atlantic and needed to be examined. Instead of looking at the three RFMOs located in the Northwest Atlantic (NAFO, ICCAT and NASCO[5]) this project decided it was best to look at only NAFO and ICCAT because they directly relate to sharks, whereas NASCO specifically deals with only salmon stocks (Lodge, 2007).

II. Following the first literature review an **in-depth literature review** was undertaken of the relevant international shark management and international ocean management literature. The review consisted of stock assessments, academic articles, RFMO conservation and management measures, RFMO working papers, performance reviews, FAO documents, UN documents and UNGA resolutions. All literature was found online at the Dalhousie Library website in the form of online books, journals and articles. Additional information was discovered within other websites such as UN websites, intergovernmental agency websites and news websites.

III. During the literature review a **policy analysis** was completed for international and RFMO resolutions relating to international shark management. Completing a policy analysis of all relevant frameworks for the international management of sharks allowed for this project to see the difference between how sharks are managed within RFMOs and how they should be managed according to international frameworks.

[5] North Atlantic Salmon Conservation Organization

IV. The second section of this project **analyzed** the shark management data from ICCAT and NAFO using the **ecosystem approach**. The ecosystem approach was chosen to analyse the data because after the policy analysis was completed it was clear that the ecosystem approach was the most accepted management framework for how sharks should be managed. Not only did academics call for the ecosystem approach to be applied in international shark management, but so did international frameworks such as the CBD, IPOA-Sharks and the Fisheries Code of Conduct to name a few (CBD Secretariat 2016; FAO, 2008; Lack and Sant, 2011).

Analyzing all shark resolutions within NAFO and ICCAT to determine whether or not they have been applying an ecosystem approach completed the last step of this project's analysis. The indicators were established and created by understanding and researching what the ecosystem approach entails and how it should be applied. By reading the CBD, the FAO Fisheries Code of Conduct and other academic articles relating to the approach the process was completed (Engler, 2015). Creating indicators allowed the project to be as objective as possible when evaluating NAFO's and ICCAT's application of the ecosystem towards international shark management.

The tricky nature and complexity of the ecosystem approach required the project to create simple indicators that could be answered from one of three possibilities (Yes/No/Unsure) (Engler, 2015). Originally, the project had 15 indicators but narrowed the results down to 10 indicators to eliminate over-complexity (see Table 2). The project examined all past, current and potential future shark management and conservation measures within ICCAT and NAFO to determine if the approach had been applied.

Table 2: List of Indicators (indicators in yellow were not used)

Indicators	Description
Consideration of the whole ecosystem, including humans	RFMOs need to take a holistic approach to international shark management and take into account the entire ecosystem (Engler, 2015).
Balance of diverse societal objectives with conservation objectives	The balance between human needs (fishing) cannot outweigh the needs of marine species.
Adoption of the precautionary approach	Requires RFMOs and states to proceed with caution if the required data or knowledge is not available in order to prevent harm to a certain species or ecosystem and to take measures to prevent more harm from arising (UNEP, 1992). Requires RFMOs to determine the status of the stock(s) relative to limit and target reference points, to predict outcomes of management alternatives for reaching the target and avoiding the limits, and to characterise the uncertainty in both cases (de Bruyn et al., 2013).
Adoption of adaptive management	Requires RFMOs and states to deal with the complex and dynamic nature of ecosystems and the absence of complete knowledge or understanding of their functioning (CBD, 2016a). Adaptive management accrues information overtime to eliminate uncertainty and improve management decisions.
Informed management decisions using up-to-date knowledge/data	Need updated knowledge and research to be able to make the proper management decisions regarding a species.
Encouragement for improved and updated knowledge and science	Need to encourage states to continuously be updating their science and knowledge surrounding sharks otherwise, certain actions may cause more harm than good to a species.
Adoption of measures to rehabilitate threatened or endangered species	If the species is threatened or vulnerable there should be protective measures in place to help with its recovery.
Encouragement of the improvement of selective and environmentally safe fishing gear and practices	Need to encourage states to research new ways to limit the bycatch of sharks.
Use of ecologically defined boundaries	The use of ecologically defined boundaries means that an RFMO does not follow the usual political or administrative boundaries and instead, the RFMO follows ecosystem boundaries (Engler, 2015).
Management measures that focus on the long term	RFMOs cannot solely focus on the short term management of species and rather they must focus on the long term sustainability of species.
Reviews and/or assessments regarding the effectiveness of shark-related measures	--
Attempting to work with other RFMOs	--
Taking into account developing countries' needs, resources and financial circumstances when implementing measures	--
Management is based on collaborative decision making	--
Management is decentralized to the lowest appropriate level	--

V. To understand if other RFMOs had been applying an ecosystem approach towards shark management and if ICCAT and NAFO were on par with other RFMOs, this project conducted a comparative analysis of how six other RFMOs manage sharks. Examining other RFMOs' shark conservation measures completed this analysis. The RFMOs included: the North-East Atlantic Fisheries Commission (NEAFC), the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), the Indian Ocean Tuna Commission (IOTC), the Inter-American Tropical Tuna Commission (IATTC), and the Western and Central Pacific Fisheries Commission (WCPFC). These RFMOs were selected because IATTC, IOTC, CCSBT and WCPFC represent the remaining tuna RFMOs who have taken the most responsibility for protecting sharks (Osch, 2012). Additionally, NEAFC was chosen because of its resemblance to NAFO, and CCAMLR was chosen to demonstrate its uniqueness compared to the other RFMOs.

VI. A **final literature review** was completed to help determine the most suitable **recommendations** for how sharks should be managed internationally and how the ecosystem approach should be applied by RFMOs to successfully manage sharks. The review was completed using academic articles, UN documents and FAO documents. This final literature review allowed this project to provide the most feasible recommendations for ICCAT and NAFO on how they should be applying the ecosystem approach towards shark management.

Limitations

A limitation this project had to overcome was the creation of indicators for the ecosystem approach. The indicators are perhaps too broad, may not represent the entirety of what the ecosystem approach entails, or properly represent whether or not the ecosystem approach has

been applied within NAFO and ICCAT. However, to overcome this limitation this project spent extensive time performing a literature review surrounding the ecosystem approach and extracted the most important and universally accepted aspects of the approach to help create simple but competent indicators.

A second limitation occurred when providing recommendations for ICCAT and NAFO for the future of shark management. Some of the recommendations may be feasible while others may not. To overcome this limitation this project attempted to understand the different variables that impacted the governance and management of NAFO and ICCAT. This was completed by looking at RFMO size, RFMO convention area, RFMO age, contracting parties, past experiences, and past attempts to change shark measures.

8. Chapter 8 – *Ecosystem Approach Analysis*

The results from the indicators below demonstrate that at some levels ICCAT and NAFO are applying the ecosystem approach when managing porbeagles, shortfin makos and blue sharks. However, there are many areas that are still lacking in the full implementation of the ecosystem approach (Russell and VanderZwaag, 2010a). This chapter will examine where both ICCAT and NAFO have and have not been applying the ecosystem approach towards the management of porbeagles, shortfin makos and blue sharks in the Northwest Atlantic (see Tables 3 and 4).

8.1 Application of the ecosystem approach ICCAT

Indicator	**Yes**	**No**	**Unsure**
1. Consideration of the whole ecosystem, including humans		X	
2. Balance of diverse societal objectives with conservation objectives		X	
3. Adoption of the Precautionary Approach		X	
4. Adoption of Adaptive Management		X	
5. Informed management decisions using up-to-date knowledge/data		X	
6. Encouragement for improved and updated knowledge and science	X		
7. Adoption of measures to rehabilitate threatened or endangered species	X[6]		
8. Encouragement of the improvement of selective and environmentally safe fishing gear and practices	X		
9. Use of ecologically defined boundaries	X		
10. Management measures that focus on the long term	X[7]		

Table 3: Application of the ecosystem approach towards sharks in ICCAT

[6] Some restrictions on Porbeagle and Shortfin Mako (COFI TUNAS, 2015)
[7] ICCAT has different development programs in place that focus on the long term and the application of the ecosystem approach (ICCAT SRDCP, 2015).

1. Consideration of the whole ecosystem, including humans

ICCAT has been given a "No" for this indicator because ICCAT has only made limited attempts to include entire ecosystems. For example Res 15-02 regarding FADs calls on CPs to use non-entangling FADs by the end of 2016, illustrating that ICCAT is taking into consideration not just the importance of FADs for fishers but the importance of limiting the bycatch of sharks and other marine animals such as turtles and seabirds caused by FADs (COFA TUNAS, 2015).

Unfortunately, ICCAT has not entirely taken a holistic approach when managing migratory shark species. For example, ICCAT has particular and divergent measures for different shark species, highlighting single-species management. Resolution 14-06 calls for improved research surrounding shortfin makos while Resolution 15-06 calls for a complete fishing prohibition on porbeagles. The two different measures, for both equally vulnerable species, demonstrates that ICCAT is not fulfilling this indicator (COFA TUNAS, 2015). Therefore, the single-species approach should be critically examined because managing species on a species to species basis leaves out or forgets key aspects of the ecosystem, while not addressing potential long term ecological changes. Furthermore, the health of an ecosystem depends on more than just the health of one particularly well managed species (Kirk, 2005; Simberloff, 1998). Lastly, ICCAT's unsuccessful action at protecting more than just a few migratory sharks shows that the whole ecosystem is not under consideration when managing sharks (COFA TUNAS, 2015).

2. Balance of diverse societal objectives with conservation objectives

Although this indicator is difficult to measure, it can easily be observed that ICCAT has placed a bigger emphasis on societal objectives rather than conservation objectives. ICCAT still has in place the 5% fin-to-weight ratio in contrast to the recommendations of academics that have proven that the ratio is ineffective on numerous occasions (Anderson, 2012; Biery and

Pauly, 2012). Furthermore, ICCAT has only recently taken action to protect porbeagle populations even though it was indicated by various member states eight years ago that porbeagle populations were in danger (Levesque, 2008). This lack of action is not entirely the fault of ICCAT but CPs as well; however, the responsibility to properly manage sharks ultimately falls upon ICCAT. Additionally, there has been a plethora of evidence from scientists who have recommended that ICCAT protect more shark species because of low population numbers (Cotter, 2010). Nevertheless no action was taken, which suggests that societal objectives (e.g. financial gain) override conservation objectives.

3. Adoption of the Precautionary Approach

In practical terms, the precautionary approach requires RFMOs, governments and organizations to proceed with caution if the required data or knowledge is not available in order to prevent harm to a certain species or ecosystem, and to take measures to prevent more harm from arising[8] (UNEP, 1992). The precautionary approach should be applied within all RFMOs according to the UNFSA (Osch, 2012). Only in 2015 did ICCAT adopt Resolution 15-12 which dictates that ICCAT must use the precautionary approach when managing fisheries; however, this does not mean it has been applied nor has the approach been officially included within ICCAT's Convention (ICCAT, 2015; Russell, 2010). This project believes that ICCAT has attempted to apply the precautionary approach towards shark management insofar as conducting shark stock assessments and predicting outcomes of recovery strategies, but has failed when it comes to avoiding limits and characterizing uncertainty for shark management.

The continued application of the faulty and highly criticized 5% fin-to-weight ratio contributes to shark population decreases (Anderson, 2013 & Biery; Pauly 2012); thus,

[8] For a more detailed description of the precautionary approach refer to Table 2.

demonstrating that ICCAI is not implementing the best scientific advice that could prevent harm to threatened species. Furthermore given the uncertainty about blue shark population numbers, ICCAT has not attempted to limit the bycatch of blue shark populations even though blue sharks are considered "near-threatened" by the IUCN (Campana et al., 2015). Additionally, ICCAT has not improved its assessment methods for blue sharks in order to get more accurate representation of blue shark population numbers so that better management options can be pursued (ICCAT SCRS, 2009; Stevens, 2009). Therefore, ICCAT has not been applying the precautionary approach towards sharks.

4. Adoption of Adaptive Management

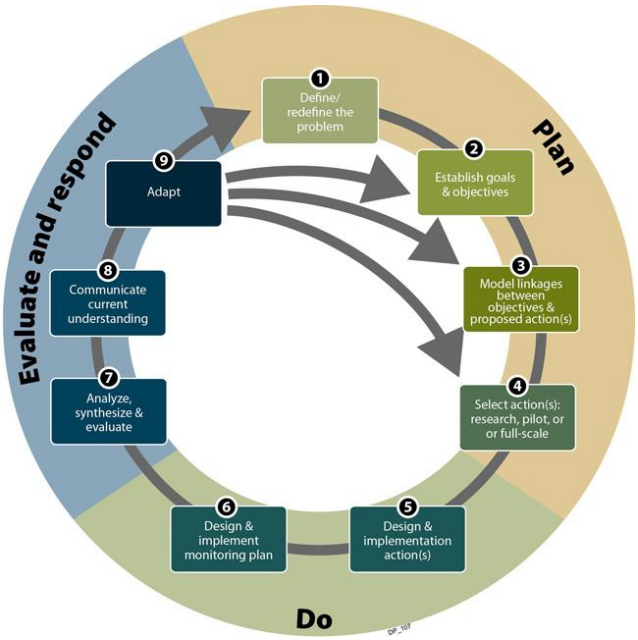


Figure 9: Adaptive Management Diagram
Source: www.dfg.ca.gov

Adaptive management is illustrated in Figure 9 and can be divided into three main phases. The "planning" phase, the "doing" phase, and the "evaluate and respond" phase. Webster declares that neither ICCAT nor NAFO have applied adaptive management towards highly migratory sharks in the Northwest Atlantic (2009). Instead, Webster argues that there needs to be an approach that captures the underlying dynamics of fisheries economics but remains "malleable in the face of institutional, scientific, biological and political variations (2009)." Webster (2009) is right to say that ICCAT does not have adaptive management when it comes to sharks because within all of ICCAT resolutions and measures not once is there a discussion or reference to adaptive

management (COFA TUNAS, 2015). Nonetheless, ICCAT does have a mechanism to react to the rapid response of unexpected effects of fishing or natural catastrophes, but this mechanism has never been used on shark populations (de Bruyn et al., 2013). For example, it was not until 2015 that porbeagle sharks were allotted some form of protection (Res 15-06), even though for over eight years porbeagles were identified as vulnerable by the IUCN. ICCAT's lack of ability to adapt to a current situation demonstrates their failure at applying adaptive management towards the international management of sharks. Additionally, ICCAT has not been able to protect shortfin makos even though they share the same conservation status as porbeagles. This evidence suggests that the first and second phases of adaptive management seem to be present within ICCAT but the final phase of being able to respond to the issues at hand appears to be lacking (COFI TUNAS, 2015).

5. Informed management decisions using up-to-date knowledge/data

ICCAT currently has a Shark Research and Data Collection Programme (SRDCP) which goals are to improve the quality of knowledge, reduce uncertainty of the scientific advice on sharks provided to the Commission and to better assess the impact of management measures on shark species (ICCAT Shark Research and Data Collection Programme, 2014). However, there have been no reports or updates that have come from SRDCP since it was founded in early 2015. This potentially suggests that the SRDCP is not publishing or perhaps not collecting "up-to-date" data regarding sharks. Lack and Sant also point out that ICCAT does not always follow the scientific data provided by the Scientific Council (e.g. 5% fin-to-weight ratio) (Lack and Sant, 2011). Additionally, after reviewing the stock assessments for porbeagle, shortfin mako and blue shark it is evident and clearly stated in all three assessments that data is missing to properly assess the three shark populations (ICCAT SCRS, 2009). This highlights that potential shark

management decisions were made that lacked the sufficient data, supporting the case that management decisions, or lack of management decisions were ill-informed and did not use up-to-date knowledge (Lack and Sant, 2011).

ICCAT undertook a bycatch coordination study in 2012. The secretariat hired a bycatch coordinator to harmonize and analyze fishery datasets related to bycatch species of tuna fisheries in the ICCAT Convention area (Cotter, 2010). However, from the initial report no further reports or information has come from the bycatch coordinator, demonstrating once again that up to date data is missing for proper shark management within ICCAT (2009; 2010).

6. Encouragement for improved and updated knowledge and science

ICCAT has successfully fulfilled this indicator for managing porbeagles, shortfin makos and blue sharks within their Convention area. The encouragement for improved and updated knowledge and science is clearly stated in Resolution 04-10, calling on CPs for updated and continuous science surrounding sharks (e.g. migratory routes, nursery areas, and population size) (COFA TUNAS, 2015).

7. Adoption of measures to rehabilitate threatened or endangered species

ICCAT has measures in place to rehabilitate threatened or endangered species. The measures either prohibit the fishing of a certain shark species or call for improved science. These measures are specifically true for porbeagle under Resolution 15-06, which prohibits the fishing of porbeagle, and for shortfin mako under Resolution 14-06 that calls for improved and increased science about the species. Furthermore, ICCAT has prohibitive measures for silky, thresher, oceanic whitetip and hammerhead sharks (COFA TUNAS, 2015).

8. Encouragement of the improvement of selective and environmentally safe fishing gear and practices

Resolution 04-10 specifically encourages CPs to conduct research for the improvement of selective and environmentally safe fishing practices. Unfortunately, it is difficult to determine whether or not this kind of research is being conducted by CPs but it is important to note and understand that at least ICCAT does encourage the research and cannot directly force nation-states to undertake such research. Therefore, ICCAT has fulfilled Indicator 8 (COFA TUNAS, 2015).

9. Use of ecologically defined boundaries

The use of ecologically defined boundaries means that an organization or agency does not follow the usual political or administrative boundaries (e.g. nation-state boundaries). Instead, the organization or agency follows ecosystem boundaries. Identifying where an ecosystem starts and where it ends is not a straightforward scientific endeavour. Scientists and managers argue that the management should take place at the appropriate spatial scale, which should reflect the scale of the relevant ecological processes (e.g. climate change is a global problem, and water quality is a local problem). Therefore, Engler argues that management and in this case shark management "should be managed around the problem(s) to be solved, not political units or property lines" (2015). The management of sharks in the Northwest Atlantic is a regional problem. Fortunately, ICCAT`s Convention area encompasses the entire Atlantic Ocean. Therefore, ICCAT does not follow any particular political or administrative boundaries and manages sharks across multiple boundaries, highlighting that ICCAT uses ecologically defined boundaries (COFA TUNAS, 2015).

10. Management measures that focus on the long term

Resolution 15-06 for porbeagle and Resolution 14-06 for shortfin mako have established management measures that focus on the long term (COFA TUNAS, 2015). For example, a current long term management measure in place is the annual limiting of bycatch of porbeagles and shortfin makos (ICCAT, 2010; ICCAT, 2012).

8.2 Application of the ecosystem approach in NAFO

Indicator	**Yes**	**No**	**Unsure**
1. Consideration of the whole ecosystem, including humans		X	
2. Balance of diverse societal objectives with conservation objectives		X	
3. Adoption of the Precautionary Approach		X	
4. Adoption of Adaptive Management		X	
5. Informed management decisions using up-to-date knowledge/data		X	
6. Encouragement for improved and updated knowledge and science	X		
7. Adoption of measures to rehabilitate threatened or endangered species		X	
8. Encouragement of the improvement of selective and environmentally safe fishing gear and practices	X		
9. Use of ecologically defined boundaries	X		
10. Management measures that focus on the long term		X	

Table 4: Application of the ecosystem approach towards sharks in NAFO

1. Consideration of the whole ecosystem, including humans

NAFO by mandate solely manages sharks as bycatch and therefore, does not focus on the entire shark ecosystem when it comes to porbeagle, shortfin mako and blue shark populations (NAFO, 2016).

2. Balance of diverse societal objectives with conservation objectives

As with ICCAT, this indicator is difficult to measure. The evidence suggests that NAFO has placed a bigger emphasis on societal objectives rather than conservation objectives when it comes to shark management. This is true because NAFO still has in place the 5% fin-to-weight ratio and has no prohibitions on any of the three shark species, even though they are threatened or near-threatened (NAFO, 2016).

3. Adoption of the Precautionary Approach

NAFO has experience with the precautionary approach because of the moratorium on cod stocks that began in the 1990s (Russell and VanderZwaag, 2010a). The collapse of the cod industry imposed that NAFO take precautionary action to avoid the collapse of other fisheries for which the organization was responsible. From this experience, NAFO developed a joint working group of the Fisheries Commission and the Scientific Council on Risk-based Management Strategies to consider and address the enhancement of risk-based assessment approaches when evaluating management strategies, as well as the broad use of the precautionary approach (NAFO, n.d., Risk-based Management Strategies). Furthermore, NAFO's newly amended and adopted but not yet ratified Convention, includes the precautionary approach (NAFO, 2007).

De Bruyn et al. argued that in NAFO's management of a select few species the precautionary approach has been applied, while for other species such as sharks, the precautionary approach has not been applied. NAFO has never conducted any assessment on shark populations (de Bruyn et al., 2013; NAFO 2015). NAFO has not adopted any form of new or revised shark conservation and management measure since 2006, even in the face of new data surrounding shark population numbers (NAFO, 2006). On top of NAFO not changing their conservation and enforcement measures to reflect the latest scientific advice, NAFO has not

attempted to gather new data about shark populations within their Regulatory area. This demonstrates a lack of interest in properly conserving and managing sharks (Lack and Sant, 2011). Furthermore, Russell argues that NAFO commonly does not abide by the scientific advice available, demonstrating a failure to manage stocks and bycatch with precaution (Russell, 2010). NAFO has not applied the precautionary approach when managing migratory sharks in the Northwest Atlantic.

4. Adoption of Adaptive Management

NAFO has not applied adaptive management schemes when managing shark populations (Webster, 2009). NAFO has no long-term development goals for any shark population nor does NAFO have a monitoring plan for sharks. Furthermore, NAFO has not adopted any new shark measures since 2006 to adapt with changing shark population numbers (Campana et al., 2012; NAFO, 2006). Therefore, NAFO has not been applying adaptive management towards sharks in the Northwest Atlantic.

5. Informed management decisions using up-to-date knowledge/data

NAFO, like ICCAT, lacks data surrounding shark populations and therefore, their decisions encompassing shark measures or lack of decisions demonstrates that NAFO is not using up-to-date knowledge/data to inform management decisions (Lack and Sant, 2011; NAFO, 2016; Russell, 2010). NAFO's website has few publications by NAFO scientists about sharks in the Northwest Atlantic, suggesting that perhaps NAFO does not catch many sharks. Additionally, "catch" may refer only to landings and not discards. Therefore, many fishers may not be recording shark discards, making the shark data that NAFO acquires not up to date or inaccurate (IISD, 2016; Lack and Sant 2009; K. Schleit, personnel communication, Sept. 8,

2016). Therefore, the evidence suggests that NAFO is not using up-to-date knowledge to inform management decisions.

6. Encouragement for improved and updated knowledge and science

Article 12 of NAFO's Conservation and Enforcement Measures directly encourages for improving and updating knowledge and science by CPs surrounding shark populations in the Northwest Atlantic, demonstrating that NAFO is fulfilling Indicator 6 (NAFO, 2016).

7. Adoption of measures to rehabilitate threatened or endangered species

NAFO has no measures in place to rehabilitate porbeagle, blue shark or shortfin mako populations (NAFO, 2016).

8. Encouragement of the improvement of selective and environmentally safe fishing gear and practices

Article 12 of NAFO's Conservation and Enforcement measures encourages the improvement of selective and environmentally safe fishing gear and practices (NAFO, 2016).

9. Use of ecologically defined boundaries

NAFO, like ICCAT, follows ecologically defined boundaries. NAFO's Regulatory area specifically focuses on the Northwest Atlantic ecosystem as a whole. Therefore, NAFO takes a regional approach to international shark management, which is necessary for species that migrate across multiple boundaries (NAFO, 2016).

10. Management Measures that focus on the long term

NAFO currently has no strategic plan for all three indicated shark populations, nor do they have plans that focus on the long term recovery or sustainability of the three shark

populations (NAFO, 2016). Nonetheless, NAFO has created a "Roadmap for EAF[9]" which lays out the organizing framework and guiding set of principles to implement the ecosystem approach in the long term management of fisheries. Additionally, the Roadmap is interested in the stronger combination of science and management strategies with the hopes of successfully managing fisheries (NAFO SC, 2013). However, little has come from the Roadmap. There are limited resources such as the scientific capacity within NAFO to complete the Roadmap's objectives, there are coordination and compatibility problems with coastal states, and the long term management of sharks are of minimal concern for the Roadmap (Koen-Alonso, 2016). Therefore, NAFO has no management measures that focus on the long term management of sharks.

8.3 Discussion

The use of indicators to determine whether or not ICCAT and NAFO have been applying the ecosystem approach is tricky because of the confusing nature and complexity of the approach (Engler, 2015; Russell and VanderZwaag, 2010). However, and aforementioned in Chapter 7, the indicators serve to the best of their ability as a framework to outline the key factors of what the ecosystem approach entails and to present the current state of international shark management in the Northwest Atlantic (Jennings, 2005).

At the most recent conference held by International Institute for Sustainable Development in May 2016, which discussed the creation of a mechanism to protect biodiversity within areas beyond national jurisdiction, the EU and the United States declared that RFMOs are still not properly applying the ecosystem approach when it comes to managing high-seas species.

[9] EAF stands for Ecosystem Approach to Fisheries.

The delegates expressed that the ecosystem and precautionary approach were not being completely applied towards shark management because single-stock management still exists, there has been a lack of data collection by RFMOs, and there have been continuous failures to address the high levels of bycatch of sharks. Delegates from the US, EU and Republic of Korea all argued that there is a need for a more holistic approach towards target and bycatch species and increased species-specific data about sharks (IISD, 2016).

The goal of the ecosystem approach is to maintain ecosystems in healthy, productive and resilient conditions so that the ecosystems can survive and provide resources for humans (Jennings, 2005); but, after looking at shark population numbers these goals are not being reached (Baum et al., 2003). This indicates that NAFO and ICCAT still have to amend and adopt new measures that will allow them to properly apply the ecosystem approach towards shark management in the Northwest Atlantic.

9. Chapter 9 – Comparative Analysis of other RFMO Shark Management Measures

The results show that NAFO and ICCAT are still not fully implementing the ecosystem approach. In order to understand how well ICCAT and NAFO are managing sharks there needs to be a global examination of how sharks are managed in areas beyond national jurisdictions by other RFMOs. Therefore, this project analyzed how other RFMOs are managing sharks in international waters. Research shows that shark populations are declining globally, indicating that measures should universally be adopted within RFMOs to improve shark conservation and management on the high seas (Myers and Worm, 2003). For an overview analysis of the different shark conservation and management measures in the aforementioned RFMOs see Table 5.

Table 5: RFMO shark measures

RFMOS	Fins-attached	5% Fins Ratio	Discard/bycatch measures	Catch Measures (TACs)	Reporting Requirements	Gear Measures	Prohibited shark species	Shark-related research	NPOAs requested
CCAMLR*			✓				✓		
CCSBT**									
IATTC		✓	✓		✓	✓	✓ - Oceanic Whitetip	✓	✓
ICCAT		✓	✓		✓	✓	✓ -whitetip, hammerhead, silky, thresher	✓	✓
IOTC		✓	✓		✓	✓	✓- oceanic whitetip (not binding in India) and thresher sharks	✓	
NAFO		✓	✓	✓	✓	✓		✓	
NEAFC	✓		✓	✓	✓	✓	✓- Basking & Porbeagle	✓	
WCPFC		✓	✓	✓	✓	✓	✓ - oceanic whitetip and silky shark		✓
TOTAL	1	5	7	3	6	6	6	5	3

*The CCAMLR prohibits all shark fisheries except for research purposes
**The CCSBT does not yet have any binding shark regulations in place

9.1 Tuna RFMOs

9.1.A Commission for the Conservation of Southern Bluefin Tuna (CCSBT)

CCSBT is a relatively new tuna RFMO that came into being in the mid-1990s. The Commission is dedicated to protecting southern Bluefin tuna. CCSBT shares the same measures as IOTC and WCPFC in order to limit the problems that could arise due to overlapping convention areas (see Figure 10) but, none of the resolutions or recommendations adopted within CCSBT are binding for CPs. Rather, CCSBT acts as a platform for CPs to discuss the management of southern bluefin tuna. CCSBT does have working groups looking at sharks and methods to improve shark management (Ecologically Related Species Working Group, 2005). Additionally, CCSBT does not carry out stock assessments for sharks (Lack and Sant, 2011). Since CCSBT does not have binding resolutions, the management of migratory sharks within its Convention is relatively ineffective.

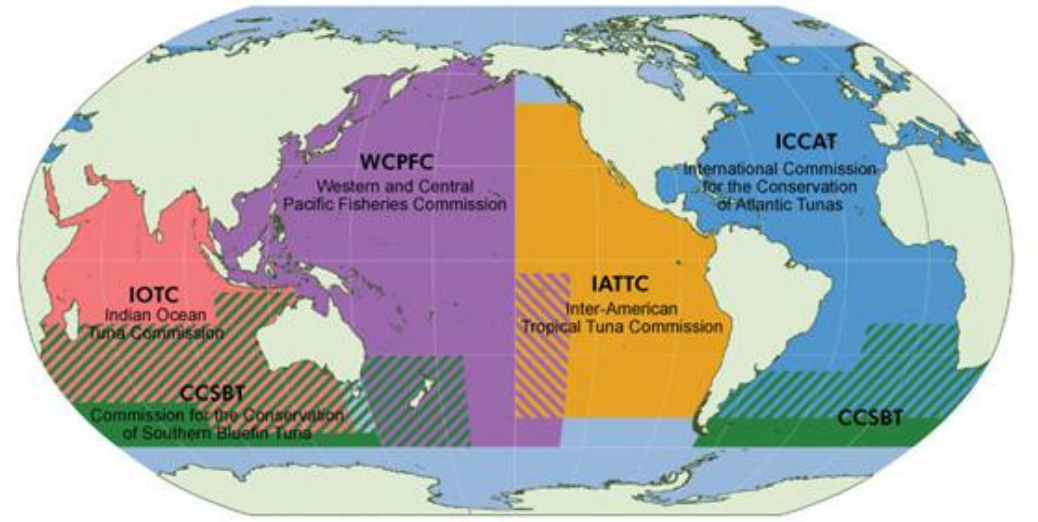


Figure 10: Tuna RFMO Convention Areas

Source: www.pewtrusts.org

9.1.B Inter-American Tropical Tuna Commission (IATTC)

IATTC is the equivalent to ICCAT, except located within the Pacific Ocean. IATTC shares many of the same shark resolutions as ICCAT and other RFMOs (IATTC, 2005). IATTC has conducted population assessments for silky sharks and hammerhead sharks (Aires-da-Silva

et al., 2015; Roman-Verdesoto and Hall, 2014). IATTC has only one prohibition on oceanic whitetip sharks (IATTC, 2011). However, it can be argued that hammerhead species are experiencing the same population decline as oceanic whitetips and therefore, should have the same form of protection under IATTC. Unfortunately, hammerhead species do not share the same protections (Roman-Verdesoto and Hall, 2014). Resolution C-13-04 forces CPs to use biodegradable and improved FADs with the gradual phasing out of FAD designs that do not mitigate the entanglement of sharks, demonstrating IATTC's efforts to minimize shark bycatch. Furthermore, IATTC requires CPs to ensure that their fishing vessels remove their purse seines from the water if a whale shark has been spotted in the area that they are fishing (IATTC, 2013). IATTC is attempting to conserve and manage shark populations but is not a leader in international shark management.

9.1.C Indian Ocean Tuna Commission (IOTC)

The IOTC has many of the same resolutions as other tuna RFMOs. For example, the IOTC realizes the issues surrounding FADs and is attempting to phase them out, while also realizing the harm purse seines can have on whale sharks. Therefore, under Res 13/05 a requirement of CPs is to ensure no vessels intentionally set a purse seine around a whale shark and report all whale shark sightings to the IOTC. Additionally, the IOTC no longer allows the use of drift nets on the high seas due to their likelihood of shark bycatch. The IOTC has prohibitions on thresher sharks and oceanic whitetip sharks; however, the prohibition of oceanic whitetip sharks is not binding for India. The IOTC is the only tuna RFMO that does not call on its CPs to create and enact the NPOA-Sharks (IOTC, 2015). Furthermore, IOTC does not know the stock status of any shark population (including shortfin mako and blue sharks). The IOTC

attempts to evaluate certain shark stocks under executive summaries of stocks but the information is limited and there are large knowledge gaps (IOTC, 2016).

9.1. D Western and Central Pacific Fisheries Commission (WCPFC)

The WCPFC is the newest tuna RFMO and its convention area is located within the western half of the Pacific Ocean. WCPFC has adopted similar measures for sharks for those endangered within other RFMOs (WCPFC, 2014). WCPFC has a prohibition on silky sharks, oceanic whitetips and has the same measures as IATTC and IOTC to protect whale sharks (WCPFC, 2011; WCPFC, 2012; WCPFC, 2013). Unlike other tuna RFMOs, WCPFC has created certain catch measures for fisheries that directly target sharks. The requirements for these measures place the burden on nation-states to properly manage straddling sharks at appropriate and sustainable measures otherwise; the WCPFC will have to act accordingly to conserve the species (WCPFC, 2014). The WCPFC has done assessments on silky sharks, oceanic whitetip sharks and north pacific blue sharks (Rice and Shelton, 2013; Rice et al., 2014).

9.2 Non-Tuna RFMOs

9.2.A Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)

CCAMLR is an RFMO that is dedicated to managing and conserving all marine living resources in the Antarctic. CCAMLR has prohibited the retention and catch of any sharks located within its Convention area (See Figure 11). Therefore, there is no need to have any other form of shark measure in place because no shark fishing is allowed. The measure differs from any other RFMO who only have prohibitions on a select few species, or none at all (CCAMLR, 2006).

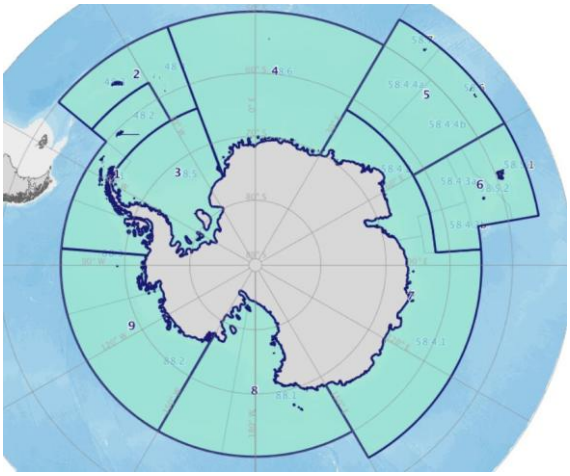


Figure 11: CCAMLR Convention Area

Source: www.ccamlr.org

Few elasmobranch occur within the cold Antarctic waters and fishing pressure may not be as prominent compared to elsewhere (Osch, 2012). Therefore, the complete prohibition on all shark populations is possible in the Antarctic but not for other RFMOs such as NAFO and ICCAT. Additionally, there is little information surrounding sharks within CCAMLR's Convention area. The lack of data makes it difficult to assess whether or not shark populations are healthy within CCAMLR to compare to other shark populations (Myers and Worm, 2003).

9.2.B North-East Atlantic Fisheries Commission (NEAFC)

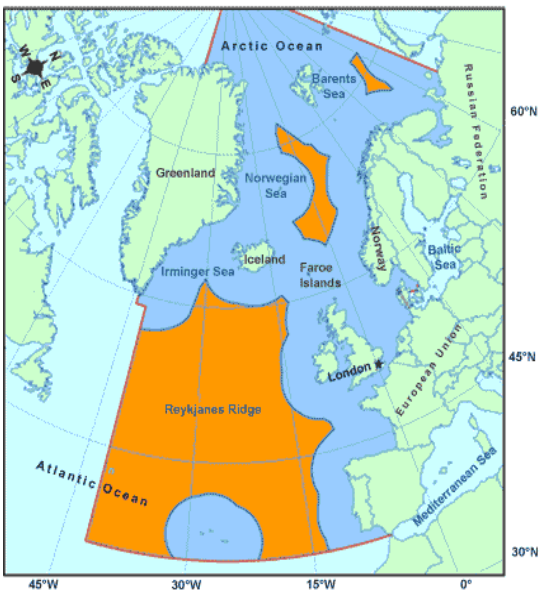


Figure 12: NEAFC Convention Area

Source: archive.neafc.org

NEAFC resembles NAFO because both RFMOs are considered to be "ground-fish" RFMOs located in the North Atlantic (see Figure 12). Therefore, one could assume that both RFMOs have adopted similar shark management measures. Indeed NEAFC does share many of the same measures as NAFO; however, NEAFC has additional measures in place for the conservation of sharks that NAFO does not (NEAFC, 2015). For example, NEAFC has prohibitions on basking sharks and seventeen different deep sea sharks (NEAFC, 2013; NEAFC, 2016 Rec 8:2016). Recently, NEAFC adopted a recommendation to stop fishing porbeagle until 2019 because of low population numbers and to permit the Scientific Council to better assess the population's status (NEAFC, 2016 Rec 7:2016). Furthermore, NEAFC has

become the first RFMO to adopt a 'fins-attached' policy, meaning that NEAFC now prohibits the removal of shark fins at sea (NEAFC, 2015).

9.3 Comparative Analysis: Results

After examining and comparing the above RFMOs with ICCAT and NAFO one can see many similarities in the way sharks are managed by different RFMOs, with some RFMOs performing better than others. For example, many RFMOs advocate for improved gear and technology to limit bycatch, improved shark research to identify key breeding and spawning areas, and have similar reporting requirements.

Additionally, there are differences between RFMOs and disparities on a global scale of how RFMOs manage sharks. For example, only a select few species of sharks are protected within each RFMO, when the evidence suggests that more shark species should be protected and should be prohibited from fishing (Myers and Worm, 2003). NEAFC is the only RFMO to adopt a 'fins-attached' policy while all other RFMOs still have the 5% fin-to-weight. The 'fins-attached' policy adopted by NEAFC makes it a leader in the international management of sharks.

Additionally, the results from Table 5 indicate that few RFMOs request their CPsto institute their own NPOAs, especially in the non-tuna RFMOs. The application of NPOAs could greatly influence the success of shark management. Stock assessments for sharks are lacking. If RFMOs wish to properly conserve and manage sharks there needs to be stock assessments or a certain form of evaluation so the proper management measures can be pursued. Otherwise the precautionary approach should be applied, which has not been the case in many RFMOs (Staples and Funge-Smith, 2009). Furthermore, the lack of stock assessments suggests that sharks are not a priority and more of a burden for RFMOs. Lastly, there is a lack of catch measures for sharks.

If international shark management is to be successful, RFMOs must be able to learn from each other and work together. One successful shark measure in a RFMO may also be successful and compatible in another RFMO. Additionally, certain shark measures need to change because they are out-dated and are not sufficient to protect sharks (e.g. 5% fin ratio). Sharks can successfully be managed by RFMOs but measures need to change and sharks must be taken off the "back burner" and put on the front. The above RFMOs share similar shark measures to NAFO and ICCAT and therefore, are likely experiencing the same problems towards international shark management.

10. Chapter 10 – *Discussion*

RFMOs are not fully applying the ecosystem approach when it comes to managing shark species and sharks are still not seen as a priority for RFMOs as global shark populations continue to decline. Continuous calls for action by governments, NGOs and other organizations have resulted in slow or little progress (Lack and Sant, 2011). Yet, new evidence suggests there is some hope for sharks globally.

One of the main causes of declines of shark populations is overfishing for finning (Anderson, 2011; Biery and Pauly, 2012). With little action being taken RFMOs to limit shark finning (besides NEAFC), shark finning easily could have increased; fortunately, this is not the case. Surveys and research conducted in China (the biggest shark importing country) by WildAid in 2014 illustrate a significant decline in the weight of shark fin imports from 2011-2013 (See Table 6). The surveys were conducted in Shanghai, Beijing, Guangzhou and Chengdu. Furthermore, the surveys indicated that ninety-one percent of participants agreed that the Chinese government should impose a ban on all shark fin trade (Whitcraft et al., 2014); thus, demonstrating that perhaps demand for shark products, especially fins, in China is declining.

Year	Weight of Imports	Decrease
2011	10,292,421 kg	--
2012	8,254,332 kg	20% decrease
2013	5,390,122 kg	35% decrease

Table 6: Decline of shark fin imports to China from 2011-2013

Table 6 illustrates that shark finning has been decreasing at substantial amounts from 2011. This decline is not attributed to the work being completed by RFMOs but by environmental organizations, celebrities and other agencies. For example, Yao Ming has become the face of ending the shark fin trade and studies show that Yao's influence and presence in the matter is aiding in the fight to end the trade in China (Whitcraft et al., 2014). This decline in finning is especially important for porbeagles, shortfin makos and blue sharks that are sometimes specifically targeted for their fins (Cailliet et al., 2009). With the successful work being completed by actors other than RFMOs one could suggest that RFMOs should focus on other issues facing shark populations. However, should RFMOs even be focusing on sharks in the first place?

Across the globe tuna RFMOs have taken on the main responsibility of managing highly migratory sharks, while non-tuna RFMOs have taken whatever responsibility they deem fit (Osch, 2012). However, unless the RFMO specifically states in their mandate or convention that sharks are not under their jurisdiction should they not attempt to make a valid effort to manage sharks? To answer this question one has to look at both NAFO's and ICCAT's conventions to see if they mention the management of sharks. ICCAT's Convention under Article IV declares that ICCAT is responsible for "tuna and tuna-like species (e.g. marlins and sailfish) and such other species of fishes exploited in tuna fishing in the Convention area as are not under investigation by another international fishery organization (ICCAT, 2007)." Therefore, it makes sense for ICCAT to manage sharks because sharks are exploited mostly as bycatch by the tuna fishing industry (Pew Environment Group, 2012). Furthermore, taking into consideration that ICCAT's Convention area covers the entire Atlantic Ocean, it is only reasonable for ICCAT to play a dominant role in managing sharks that migrate across multiple political boundaries.

NAFO's Convention under Article 1.4 declares that NAFO is responsible for all fisheries resources in the Convention area with exceptions to: salmon, tuna, cetaceans and sedentary species of the continental shelf (NAFO, 2004). Therefore, according to NAFO's Convention sharks should also be a priority. Aforementioned, NAFO has played a small role in the management of sharks but who decides how big a role NAFO should play? This project believes that NAFO needs to take a more dominant role in the responsibility of managing sharks. Cetaceans, unlike sharks located on the high seas, acquire protection through the International Whaling Commission. However, there are no international organizations that specifically dedicate their work to managing sharks on the high seas (Anderson, 2011). Shark populations are severely suffering and the shark work being completed by tuna RFMOs are only helping a selective few species. If the pre-existing RFMOs such as NAFO, do not attempt to manage sharks there is a void and shark populations could continue to significantly decline. NAFO should be playing the same role in managing sharks as NEAFC because they are both very similar RFMOs. Furthermore, if RFMOs wish to apply the ecosystem approach they should take into account the entire ecosystem. By disregarding sharks the RFMO is disregarding the holistic approach to management that the ecosystem approach demands (Simons & van Menffont, 2015).

Finally, it must be mentioned that it is okay for RFMOs to have differing conservation and enforcement measures to protect sharks, as long as the RFMO continuously attempt to improve international shark management and does not undermine the work of another RFMO. Each RFMO is different and has a multitude of variables that impact how that RFMO functions. For example, ICCAT's Convention area is much bigger than NAFO's, has more CPs and many of the CPs are developing countries that may lack the funds to properly manage or implement all the measures adopted by ICCAT. Therefore, one measure may work for a particular RFMO but

not for another, indicating that variables play a heavy role in the success of fisheries management in RFMOs (Lodge, 2007). Keeping this in mind, Chapter 11 takes into consideration the variables that can impact an RFMO when deciding which recommendations are feasible for either ICCAT or NAFO.

11. Chapter 11 – *Future Directions/Recommendations*

The below recommendations and future directions for international shark management could aide in the implementation of the ecosystem approach within NAFO, ICCAT and other RFMOs. Furthermore, the recommendations provided should help in the conservation of porbeagles, shortfin makos, and blue sharks. The future directions and recommendations are divided into both global recommendations (for all RFMOs, nation-sates and other relevant stakeholders) and regional recommendations (specifically for the Northwest Atlantic).

11.1 Global

With regards to the reporting of shark data and the improvement of shark research on the high seas…

- Change reporting of sharks at FAO level.
    - Sharks should be reported at a species level (Techera and Klein, 2011). Shark identification guides are a start to this recommendation (Osch, 2012).
- National authorities should ensure that there are appropriate taxonomic specific data recording systems for both fisheries and trade concerning species pertinent to both CITES and fisheries management authorities (RFMOs).
        - The data collected will allow for informed management decisions at RFMOs.
- Intergovernmental organizations such as CITES, CMS and RFMOs should consider establishing formal liaison and data-sharing protocols on species of shared interest.
- Shark fishers, traders, distributors and retailers interested in offering certified-sustainable shark products should actively participate in constructing trade monitoring systems that support traceability and effective management (Dent and Clarke, 2015).

- ❖ Provide continuous and updated stock assessments of shark species, even if it requires increased resources (Levesque, 2008).
- ❖ RFMOs should call for more research about post-release survival of sharks in order to determine the most nonlethal post-release methods.
    - ▪ There is a strong connection between how animals are handled by fishers and their survival rates (Molina and Cooke, 2012).
- ❖ RFMOs and CPs need to examine the condition and fate of sharks once they are discarded.
    - o Evaluating post-release mortality can be completed by holding sharks in cages, pens, or tanks or alternatively by releasing sharks with electronic tags (Molina and Cooke, 2012).

With regards to protective shark measures…

- ❖ Continuous encouragement by RFMOs and CPs towards nation-states who are not a part of RFMOs and are shark fishing nations or may be catching sharks as bycatch to join the relevant RFMO (Barker and Schluessel, 2004).
- ❖ Create positive incentives for non-compliers to seek to join the RFMO or at least become a cooperative non-party that will comply with the objectives of the RFMO (Tarasofsky, 2007).
- ❖ Shark ecotourism should be advocated for by RFMOs as a method to increase awareness of the conservations status of sharks and provide alternatives to the harvesting of sharks and shark fins (Techera and Klein, 2011).

- ❖ Prohibitions on the targeting of shark species until the status of target stocks has been assessed and management measures implemented. Followed with the creation of long term development plans for shark species in order to ensure their sustainability.
- ❖ The "fins-attached" policy should be adopted by all RFMOs (Griffin et al., 2008). If RFMOs refuse to adopt the "fins-attached' policy they should instead:
    - o Clearly define the objectives of the controls and assess their role in the overall strategy for the conservation and management of sharks.
    - o Be specific regarding the weight of shark that the ratio applies to (e.g. dressed weight or live weight), and the weight of the fins that the ratio applies to (e.g. wet or dry) (Lack and Sant, 2006).
- ❖ RFMOs should establish catch documentation schemes (CDS) that are aimed at promoting sustainable fisheries and combating IUU fishing and trade (Roheim and Sutinen, 2006).
- ❖ Establish TACs for shark stocks that are regularly fished and are not threatened by fishing activity.

With regards to limiting the bycatch of sharks…

- ❖ Increased research on shark bycatch reduction strategies.
    - o Create shark avoidance methods.
        - ▪ The development of repellents could prove to be a strategy to limit shark bycatch. Sharks have a unique organ called the ampullae of Lorenzini that is used for electroreception. Permanent magnets on hooks have been shown to be deterrent agents for sharks and does not require a power input (Gilman, et al., 2006; Molina and Cooke, 2012).

- The increased use of bycatch reduction devices (BRDs); however, RFMOs need to express the importance of these devices, such as less damage to the catch and gear.

- The use of observers to monitor the effectiveness of by-catch mitigation measures on vessels.
- Continued reduction or improved FAD technology in order to decrease FAD bycatch of sharks (Lewison et al., 2004).
- Educational programs for fishers and coastal communities about the importance of sharks as predators in ecosystems.
    - If fishers who catch sharks as bycatch understand their importance they will likely attempt to release sharks unharmed.

With regards to international frameworks…

- RFMOs and nation-states can urge for the follow through and eventual implementation of Resolution 69/292 at the UNGA in a quick and timely manner so to be able to provide some form of protection for highly migratory sharks on the high seas.
- Continuous pressure by nation-states on other nation-states who refuse to place certain shark species on the appendices of CITES and CMS.
- COFI should adopt an ongoing and transparent mechanism to monitor progress on the principles of the IPOA-Sharks for all NPOAs and RPOAs in order to help other countries and regions develop their own plans of action (Lack and Sant, 2011; Techera and Klein, 2011).
- All RFMOs should call on their CPs to adopt their own NPOA-Sharks by a certain time (Lack and Sant, 2006).

- ❖ All RFMOs should call on their CPs to adopt the MoU-Sharks in a timely manner.

11.2 Regional

The global recommendations can be applied to both ICCAT and NAFO. However, global recommendations can sometimes be broad and general. Therefore, the importance of providing specific regional recommendations should not be understated. The regional recommendations for the Northwest Atlantic have been provided because their feasibility at the entire international level is unlikely. Furthermore, the regional recommendations have taken into account the multitude of variables that impact RFMOs, making certain recommendations perhaps more feasible for one RFMO over another (e.g. ICCAT over NAFO or vice versa).

- ❖ The identification and closing of Vulnerable Marine Ecosystems (VMEs), especially nursery and spawning areas for sharks. (Dell'Apa et al., 2014).
    - NAFO is comprised of many developed countries and therefore, the chances of having successful closed areas are a possibility.
    - Potential for seasonal area closures (Molina and Cooke, 2012).
    - Both NAFO and ICCAT have called for the identification of important nursery areas, yet no information has come from this. Therefore, actual research into the subject would greatly improve shark conservation measures.
- ❖ A particular recommendation for NAFO is to establish some form of aid assistance program for developing countries[10].
    - Many RFMOs such as ICCAT already have aid assistance programs in place to help countries complete research and implement new measures

[10] E.g. Cuba and Eastern European nation-states (NAFO, 2007).

and regulations (Fischer et al., 2012). In doing so, NAFO may be able to increase compliance with CPs and acquire improved knowledge about shark populations in the Northwest Atlantic.

- Improved cooperation between ICCAT and NAFO.
    - Creating a data-sharing committee between the two organizations can complete this.
- Prohibitions on threatened shark species and more species-specific measures.
        - Porbeagle and shortfin mako directly overlap with NAFO's and ICCAT's convention areas. Yet, only ICCAT has species-specific measures regarding the two sharks, while NAFO has none (see Table 7).

Species-Specific Measures	
ICCAT	NAFO
Porbeagle Shortfin Mako Whale Sharks? Oceanic Whitetip Hammerhead Silky Sharks Thresher Sharks	Thorny Skate

Table 7: Species-Specific shark measures between ICCAT and NAFO

- Similar shark prohibition measures between NAFO and ICCAT.
- Increased protection for threatened shortfin mako and blue shark populations.
- Combined stock assessments or funding from one RFMO to aid in the conducting of stock assessments.
- Improved stock assessments.

The future of international shark management in the Northwest Atlantic appears to be bleak. If the above recommendations are implemented humankind will finally have the capacity

to conserve migratory shark species. The implications of the above recommendations will not only benefit sharks but will in turn benefit humans and other species that depend on strong and resilient ecosystems.

11.3 Discussion: International Shark Commission?

Throughout the literature there are some academics that argue that there is no centralized body dedicated specifically to sharks, like how the International Whaling Commission (IWC) is dedicated specifically to whales (Anderson, 2011; Herndon et al., 2010). As a consequence, sharks are put on the backburner by many RFMOs and therefore, it makes sense that there should be the creation of some form of organization that deals specifically with sharks. The IWC has been somewhat effective at managing whales. The creation of an International Shark Commission can learn from the mistakes of the IWC. Furthermore, the literature depicts how the Commission should function and which regulations/measures should be in place to properly manage sharks (Herndon et al., 2010). However, this project believes that in theory the idea of an International Shark Commission in possible but in practice it is not.

The IWC was created to stop directed whale fishing by nations on the high seas and within domestic waters; although, many of the sharks that are caught on the high seas are a result of bycatch and not a directed fishery (Fischer at el., 2012). Furthermore, many directed shark fisheries are domestic and therefore, fall out of the scope of this project (Lack and Sant, 2011). Instead, there needs to be a focus on strengthening the structures and frameworks that are already in place. The creation of a new Commission could take years and may end up being ineffective. Sharks need to be sustainably managed now. Therefore, the use and strengthening of the current structures and frameworks is the most feasible answer to solving the global decline of sharks on

the high seas and is why the creation of an International Shark Commission was not included in the above recommendations.

12. Chapter 12 – *Conclusion*

Shark populations globally and specifically within the Northwest Atlantic have declined drastically and rapidly over the past fifty years (Baum et al., 2003; Lack and Sant, 2011). This is especially true for highly migratory sharks in the Northwest Atlantic, where porbeagle and shortfin mako are considered by the IUCN to be vulnerable and blue sharks are considered as near-threatened (Timms and Williams, 2009). Overfishing, IUU fishing, finning, and heavy bycatch of highly migratory sharks coupled with the vulnerable biological characteristics of sharks has made many populations extremely susceptible to decline or population collapse (Fischer et al., 2012).

International frameworks, resolutions, measures and laws have continuously failed to seriously protect sharks for the long term. Broad obligations, few binding instruments and voluntary frameworks have made it nearly impossible for global cooperation surrounding shark management and conservation (Russell and VanderZwaag, 2010a). Examples of CITES and CMS continuously being unable to protect shark populations demonstrates the fragmentation and disharmony of the international environmental realm and the politics of nation-states being unable to cooperate to solve global issues; thus, making it even more difficult for the successful management of sharks located within the high seas (Techera and Klein, 2011).

International documents such as the Fisheries Code of Conduct, IPOA-Sharks, MoU-Sharks and UNGA Sustainable Fisheries Resolutions dictate for the application of the ecosystem approach by RFMOs towards international shark management. After examination and review it is clear that RFMOs within the Northwest Atlantic have been limited in applying the approach for sharks within their Convention areas. Although the ecosystem approach has been called for internationally and applauded by academics and scientists as an approach that can sustainably

manage and conserve shark species, NAFO and ICCAT have not been fully implementing the approach (Engler, 2015; Russell and VanderZwaag, 2010). Measures such as the 5% fin-to-weight ratio and the lack thereof shark conservation measures (e.g. prohibitions on threatened shark species) by NAFO and ICCAT has made it impossible to successfully implement the approach.

Although NAFO and ICCAT have some similar shark conservation measures as other RFMOs, there are some RFMOs such as NEAFC making great strides for the proper management and protection of sharks within their convention areas. NAFO and ICCAT must ensure that they do not fall behind in the battle to protect sharks within the Northwest Atlantic and invest more resources into their management. The loss of sharks within the Northwest Atlantic and globally could have significant negative implications felt throughout entire ecosystems and have direct impacts on way in which humans interact with them.

It is clear that current conservation and management efforts at the regional and international levels are falling short of the efforts required to properly conserve sharks. NAFO and ICCAT have only partially been able to apply the ecosystem approach towards managing porbeagles, shortfin makos and blue sharks in the Northwest Atlantic and likely have a long way to go before successful management is reached. Granting all of this, future directions and recommendations regarding the sustainable management and the application of the ecosystem approach are easily accessible for RFMOs and have been well-researched. The next (and hardest) step is for nation-states and RFMOs to adopt and implement these measures.

Acknowledgements

Firstly, I would like to express my sincerest gratitude to my supervisor, Professor David VanderZwaag for the continuous support of my graduate project, for his patience, motivation and immense knowledge. His guidance made it possible to complete this project. Additionally, I would like to thank my two internship hosts, the Northwest Atlantic Fisheries Organization and the Ecology Action Centre for providing me with insight and expertise that greatly assisted the research for this project. Lastly, I would like to thank friends and family for their continuous support throughout this process; especially my partner who put up with the late nights of work and for helping me review the endless amounts of edits.

.

Bibliography

Aires-da-Silva, Alexandre et al. (2015). Updated Stock Status Indicators for Silky Sharks in the Eastern Pacific Ocean (1994-2014). *Inter-American Tropical Tuna Commission.* Retrieved from: https://www.iattc.org/StockAssessmentReports/StockAssessmentReport16ENG.htm.

Alder, Jackie, Lugten, Gail, Kay, Robert and Ferriss, Bridget. (n.d.). Compliance with International Fisheries Instruments. *Sea Around Us: North Atlantic*, pp. 55-80.

Anderson, Ingrid Gronstal. (2011). Jaws of Life: Developing International Shark Finning Regulations Through Lessons Learned from the International Whaling Commission. *Transnational Law and Contemporary Problems,* 20, pp. 511- 537.

Barker, Michael and Schluessel, Vera. (2004). Managing global shark fisheries: suggestions for prioritizing management strategies. Queensland: John Wiley and Sons Ltd.

Baum, JK, Myers, RA, Kehler, DG, Worm, B, Harley, SJ and Doherty, PA. (2003). Collapse and conservation of shark populations in the Northwest Atlantic. *Science,* 299, pp. 389-393.

Bedford Institute of Oceanography. (2015). Shark Fisheries. *Government of Canada*. Retrieved from: http://www.bio.gc.ca/sharks/fisheries-industrielle-en.php.

Biery, L., and Pauly, D. (2012). A global review of the species-specific shark-to-fin-to-body-mass ratio and relevant legislation. *Journal of Fish Biology*, 80, pp. 1643-1677. Doi: 10.1111/j.1095-8649.2011.03215.x.

Cailliet, G.M., Cavanagh, R.D., Kulka, D.W., Stevens, J.D., Soldo, A., Clo, S., Macias, D., Baum, J., Kohin, S., Duarte, A., Holtzhausen, J.A., Acuña, E., Amorim, A. & Domingo, A. 2009. *Isurus oxyrinchus* (Atlantic subpopulation). The IUCN Red List of Threatened Species 2009: e.T161749A5494807. http://dx.doi.org/10.2305/IUCN.UK.2009-2.RLTS.T161749A5494807.en.

Camhi, M.D., Valenti, S.V., Fordham, S.V., Fowler, S.L. and Gibson, C. 2009. *The Conservation Status of Pelagic Sharks and Rays: Report of the IUCN Shark Specialist Group Pelagic Shark Red List Workshop*. IUCN Species Survival Commission Shark Specialist Group. Newbury, UK.

Campana, S, Gibson A., Fowler, M., Dorey, A., and Joyce, W. (2012). Population Dynamics of Northwest Atlantic Porbeagle (*Lamna nasus)*, with an assessment of status and projections for recovery. *Fisheries and Oceans Canada*.

Campana, S., Fowler, M., Houlihan, D., Joyce, W., Showell, M., Miri, C., and Simpson, M. (2015). Current Status and Threats to the North Atlantic Blue Shark (*Prinace glauca)* Population in Atlantic Canada. *Fisheries and Oceans Canada.*

Canadian Science Advisory Secretariat. (2007). Recovery potential assessment report of Shortfin Mako Sharks in Atlantic Canada. *Fisheries and Oceans Canada.* Retrieved from: http://www.dfo-mpo.gc.ca/csas/Csas/status/2006/SAR-AS2006_051_E.pdf.

CBD Secretariat. 2016. Ecosystems Approach. *The Convention on Biological Diversity*. Retrieved from: https://www.cbd.int/ecosystem/description.shtml.

CCAMLR. (2006). Conservation Measure 32-18: Conservation of sharks. *Commission for the Conservation of Antarctic Marine Living Resources.* Retrieved from: https://www.ccamlr.org/en/measure-32-18-2006.

Cisneros-Montemayor, Andres, Barnes, Michele and Al-Abdulrazzak, Dalal. (2012). *Global Economic Value of Shark Ecotourism: implications for conservation.* Vancouver: Fisheries Centre University of British Columbia.

CITES. (2016). Appendices I, II and III. *Convention on the International Trade in Endangered Species of Wild Flora and Fauna.* Retrieved from: https://cites.org/sites/default/files/eng/app/2016/E-Appendices-2016-03-10.pdf.

CITES. (n.d.) Sharks and Manta Rays. *The Convention on the International Trade in Endangered Species of Wild Flora and Fauna.* Retrieved from: https://cites.org/eng/prog/shark/sharks.php.

CMS Secretariat. (2015). Memorandum of Understanding on the Conservation of Migratory Sharks (Sharks MoU). *UNEP & CMS*. Retrieved from: www.cms.int/sharks.

CMS. (2015). Memorandum of Understanding Sharks. *Convention on the Conservation of Migratory Species of Wildlife Animals.* Retrieved from: http://www.cms.int/en/legalinstrument/sharks-mou.

CMS. (2016). Convention Text. *Convention on the Conservation of Migratory Species and of Wild Animals.* Retrieved from: http://www.cms.int/en/convention-text.

CMS. (2016). Species. *Convention on the Conservation of Migratory Species and of Wild Animals.* Retrieved from: http://www.cms.int/en/species?field_species_class_tid=1857.

COFA TUNAS. (2015). Compendium Management Recommendations and Resolutions Adopted by ICCAT for the Conservation of Atlantic Tunas and Tuna-like Species. *International Commission for the Conservation of Atlantic Tunas.* Retrieved from: https://www.iccat.int/Documents/Recs/ACT_COMP_2015_ENG.pdf.

Cortez, Enric and Julia Neer. (2006).Preliminary Reassessment of the Validity of the 5% Fin to Carcass Weight Ratio for Sharks. *Col. Vol. Sci. Pap. ICCAT*, 59, pp. 1025-1036.

Cotter, John. (2010). *ICCAT Bycatch Co-ordination Study*. FishWorld Science Ltd: Madrid.

Cullis-Suzuki, Sarika & Daniel Pauly. (2010). Failing the high seas: A global evaluation of regional fisheries management organizations. *Marine Policy*, 34, pp. 1036-1042. Doi: 10.1016/j.marpol.2010.03.002.

De Bruyn, Paul, Murua, Hilario and Aranda, Martin. (2013). The Precautionary Approach to fisheries management: How this is taken into account by Tuna regional fisheries management organizations (RFMOs). *Marine Policy*, 38, pp. 397-406. Doi: 10.1016/j.marpol.2012.06.019.

Dell'Apa, Andrea, Smith, Chad M., and Kaneshiro-Pineiro, Mahealani. (2014). The Influence of Culture on the International Management of Shark Finning. *Environmental Management*, 54, 151-161. Doi: 10.1007/s00267-014-0291-1.

Dent, F., & Clarke, S. (2015). State of the global market for shark products. *FAO Technical Paper,* 196. Retrieved from: http://www.fao.org/docrep/field/003/ab825f/AB825F00.htm#TOC.

Ecologically Related Species Working Group. (2005). A handbook on Sharks Caught in SBT Fishing Grounds 2nd Edition. *Commission for the Conservation of Southern Bluefin Tuna.* Retrieved from: ftp://ftp.fao.org/fi/DOCUMENT/cwp/cwp_21/CCSBT.pdf.

Ecologically Related Species Working Group. (2011). A Handbook on Sharks Caught in SBT Fishing Grounds: 2nd Edition. *Commission on the Conservation of Southern Bluefin Tuna.*

Engler, Cecilia. (2015). Beyond rhetoric: Navigating the conceptual tangle towards effective implementation of the ecosystem approach to oceans management. *Environmental Reviews*, 23, pp. 1-33. Doi: 10.1139/er-2014-0049.

EU. (2015). Regional Fisheries Management Organizations. *European Commission Fisheries*. Retrieved from: http://ec.europa.eu/fisheries/cfp/international/rfmo/index_en.htm.

FAO. (1995). *Code of Conduct for Responsible Fisheries.* Rome: Food and Agriculture Organization of the United Nations.

FAO. (2008). Fisheries management. 2. The ecosystem approach to fisheries. 2.1 Best practices in ecosystem modelling for informing an ecosystem approach to fisheries. *FAO Fisheries Technical Guidelines for Responsible Fisheries*. No. 4, Suppl. 2, Add. 1. Rome: FAO.

FAO. (2016). International Plan of Action for Conservation and Management of Sharks: National and Regional Plans of Action. *The Food and Agriculture Organization of the United Nations.* Retrieved from: http://www.fao.org/ipoa-sharks/national-and-regional-plans-of-action/en/.

FAO. (2016). National and Regional Plans of Action – Sharks. *The Food and Agriculture Organization of the United Nations.* Retrieved from: http://www.fao.org/ipoa-sharks/national-and-regional-plans-of-action/en/.

Fischer, Johanne, et al. (2012). Review of the Implementation of the International Plan of Action for the Conservation and Management of Sharks. FAO Fisheries and Aquaculture, Circular No. 1076.

Fisheries and Aquaculture Department. (2016). Fish Aggregating Device (FAD). *Food and Agriculture Organization of the United Nations*. Retrieved from: http://www.fao.org/fishery/equipment/fad/en.

Fisheries and Aquaculture Development (2001). *What is the Code of Conduct for Responsible Fisheries.* FAO: Rome.

Fisheries and Oceans Canada. (2011). Regional Fisheries Management Organizations. *Government of Canada*. Retrieved from: http://www.dfo-mpo.gc.ca/international/dip-rfmo-eng.htm.

Gilman, Eric et al. (2006). Reducing sea turtle by-catch in pelagic longline fisheries. *Fish and Fisheries,* 7, pp. 1-22. Doi: 10.1111/j.1467-2979.2006.00196.x.

Gjerde, Kristina, Currie, Duncan, Wowak, Katerayna and Karen Sack. (2013). Ocean in peril: Reforming the management of global ocean living resources in areas beyond national jurisdiction. *Marine Pollution Bulletin*, 30, pp. 540-541. Doi: 10.1016/j.marpolbul.2013.07.037.

Godin, Aurelie and Worm, Boris. (2010). Keeping the lead: How to Strengthen Shark Conservation and Management Policies in Canada. *Marine Policy*, 34, pp. 995-1001. Doi: 10.1016/j.marpol.2010.02.006.

Griffin, E., Miller, K.L., Freitas, B., and Hirshfield, M. (2008). *Predators as Prey: Why Healthy Oceans Need Sharks*. Washington DC: Oceana.

Herndon, A., Gallucci, V., DeMaster, D. & W. Burke. (2010). The case for an international commission for the conservation and management of sharks (ICCMS). *Marine Policy*, 34, pp. 1239-1248. Doi: 10.1016/j.marpol.2010.05.001.

IATTC. (2005). Resolution C-05-03: Resolution on the Conservation of Sharks Caught in Association with Fisheries in the Eastern Pacific Ocean. *Inter-American Tropical Tuna Commission*. Retrieved from: www.iattc.org/PDFFiles2/resolutions/C-05-03-Sharks.PD.

IATTC. (2011). Resolution C-11-10: Resolution on the Conservation of Oceanic Whitetip Sharks Caught in Association with Fisheries in the Antigua Convention Area. *Inter-American Tropical Tuna Commission.* Retrieved from: https://www.iattc.org/PDFFiles2/Resolutions/C-11-10-Conservation-of-oceanic-whitetip-sharks.pdf.

IATTC. (2013). Resolution C-13-04: Collection and Analysis of Data on Fish-Aggregating Devices. *Inter-American Tropical Tuna Commission.* Retrieved from: https://www.iattc.org/pdffiles2/resolutions/c-13-04-fads.pdf.

ICCAT SCRS. (2009). Report of the 2008 Shark Stock Assessment Meeting. *Collect. Vol. Sci. Pap. International Commission on the Conservation of Atlantic Tuna*, 64, pp. 1343-1491.

ICCAT SRDCP. 2015. ICCAT Shark Research and Data Collection Programme: Executive Summary. *International Commission on the Conservation of Atlantic Tuna*. Retrieved from: https://www.iccat.int/en/ResProgs.htm.

ICCAT. (2009). Report of the 2009 Porbeagle stock assessments meeting. *International Commission on the Conservation of Atlantic Tuna.* Retrieved from: http://www.iccat.int/Documents/Meetings/Docs/2009_POR_ASSESS_ENG.pdf.

ICCAT. (2010). Report of the 2009 Porbeagle Stock Assessment Meeting. *Collect. Vol. Sci. Pap. International Commission on the Conservation of Atlantic Tuna,* 65, pp. 1909-2005.

ICCAT. (2012). 2012 Shortfin Mako Stock Assessment and Ecological Risk Assessment Meeting. *International Commission on the Conservation of Atlantic Tuna.* Retrieved from: https://www.iccat.int/Documents/Meetings/Docs/2012_SHK_ASS_ENG.pdf.

ICCAT. (2015). Executive Summary 8.13 SHK – Sharks. *International Commission on the Conservation of Atlantic Tuna.* Retrieved from: https://www.iccat.int/Documents/SCRS/ExecSum/SHK_EN.pdf.

ICCAT. (2015). Report of the 2015 ICCAT Blue Shark Stock Assessment Session. *International Commission on the Conservation of Atlantic Tuna.* Retrieved from: https://www.iccat.int/Documents/Meetings/Docs/2015_BSH%20ASSESS_REPORT_ENG.pdf.

ICCAT. (2015). Resolution by ICCAT concerning the application of an ecosystem approach to fisheries management. *International Convention for the Conservation of Atlantic Tunas.* Retrieved from: https://www.iccat.int/Documents/Recs/compendiopdf-e/2015-11-e.pdf.

ICCAT. (2015). Resolution by ICCAT concerning the use of a Precautionary Approach in Implementing ICCAT Conservation and Management Measures. *International Commission for the Conservation of Atlantic Tunas.* Retrieved from: https://www.iccat.int/Documents/Recs/compendiopdf-e/2015-12-e.pdf.

ICCAT. (n.d.). International Convention for the Conservation of Atlantic Tunas (Basic Instrument for the International Commission for the Conservation of Atlantic Tunas (ICCAT)). *International Convention for the Conservation of Atlantic Tunas.* Retrieved from: http://www.nmfs.noaa.gov/ia/agreements/regional_agreements/atlantic/iccat.pdf.

IISD. (2016). UNFSA Review Highlights. *IISD Reporting Services*, 7. Retrieved from: http://www.iisd.ca/oceans/review-fish-stocks/2016/about.html.

International Commission for the Conservation of Atlantic Tunas. (2007). *Basic Texts*. ICCAT: Madrid.

IOTC. (2015). Compendium of Active Conservation and Management Measures for the Indian Ocean Tuna Commission. *Indian Ocean Tuna Commission.* Retrieved from: www.iotc.org/cmms.

IOTC. (2016). Status summary for species of tuna and tuna-like species under the IOTC mandate, as well as other species impacted by IOTC fisheries. *Indian Ocean Tuna Commission.* Retrieved from: http://www.iotc.org/science/status-summary-species-tuna-and-tuna-species-under-iotc-mandate-well-other-species-impacted-iotc.

Jennings, Simon. (2005). Indicators to support an ecosystem approach to fisheries. *Fish and Fisheries,* 6, pp. 212-232. Doi: 10.1111/j.1467-2979.2005.00189.x.

Kirk, Donald. (2005). Species vs. Ecosystem Recovery. [Powerpoint Slides]. Retrieved from: http://www.tallgrassontario.org/Publications/Forum_SpeciesVsEcosystemRecovery.pdf.

Klimley, Peter. (2013). *The biology of sharks and rays.* Chicago: The University of Chicago Press.

Koen-Alonso, Mariano. (2016). The NAFO Roadmap for an Ecosystem Approach to Fisheries. [Powerpoint Slides]. Retrieved from: http://www.ices.dk/explore-us/projects/Documents/AORAC%20Thursday%20PPT/PM_02_Koen-Alonso_NAFO_Roadmap_ICES-AORAC_Workshop_20-22-Jan-2016_v3.pdf.

Lack, M & G. Sant. (2006). Confronting Shark Conservation Head On! TRAFFIC International: Cambridge.

Lack, M & G. Sant. (2011). The Future of Sharks: A Review of Action and Inaction. TRAFFIC International and the Pew Environmental Group.

Lack, Mary and Sant, Glen. (2009). Trends in Global Shark Catch and Recent Developments in Management. TRAFFIC International: Cambridge.

Levesque, Juan. (2008). International fisheries agreement: Review of the International Commission for the Conservation of Atlantic Tunas Case Study – Shark Management. *Marine Policy,* 32, pp. 528-533. Doi: 10.1016/j.marpol.2007.10.006.

Lewison, Rebecca, Crowder, Larry, Read, Andrew and Freeman, Sloan. (2004). Understanding impacts of fisheries bycatch on marine megafauna. *TRENDS in Ecology and Evolution,* 19, pp. 589- 604.

Lodge, Michael W., David Anderson & Terje Lobach. (2007). *Recommended Best Practices for Regional Fisheries Management Organizations.* Chatham House, London.

Lodge, Michael. (2007). *Recommended best practices for regional fisheries management organizations report of an independent panel to develop a model for improved governance by regional fisheries management organizations.* Chatham House: London.

Molina, Juan and Cooke, Steven. (2012). Trends in shark bycatch research: current status and research needs. *Reviews in Fish Biology and Fisheries,* 22, pp. 719-737. Doi: 10.1007/s11160-012-9269-3.

Mooney-Seus, M. and A. Rosenberg (2007). *Recommended Best Practices for Regional Fisheries Management Organizations – Technical Study no. 1. Regional Fisheries*

Management Organizations: Progress in Adopting the Precautionary Approach and Ecosystem-based Management. London: Chatham House.

Mull, C.G., Blasius, M.E., O'Sullivan, J.B. and Lowe, C.G. (2012). Heavy metals, trace elements, and organochlorine contaminants in muscle and liver tissue of juvenile White Sharks, *Carcharodon carcharias*, from the Southern California Bight. *Global perspectives on the biology and life history of the White Sharks.* CRC Press, Boca Raton, Florida, pp. 59-75.

Myers, Ransom and Worm, Boris. (2003). Rapid worldwide depletion of predatory fish communities. *Nature*, 423, pp. 280-283. Doi: 10.1038/nature01610.

Myers, Ransom, Baum, Julia, Shepherd, Travis, Powers, Sean and Peterson, Charles. (2007). Cascading Effects of the Loss of Apex Predatory Sharks from a Coastal Ocean. *Science*, 315 (5820), 1846-1850.

NAFO. (2004). *Convention on the Future Multilateral Cooperation in the Northwest Atlantic Fisheries.* Northwest Atlantic Fisheries Organization: Dartmouth.

NAFO. (2006). Northwest Atlantic Fisheries Organization Conservation and Enforcement Measures. *Northwest Atlantic Fisheries Organization.* Retrieved from: http://www.nafo.int/publications/frames/publications.html.

NAFO. (2007). Amendment to the Convention on Future Multilateral Cooperation in the Northwest Atlantic Fisheries. *Northwest Atlantic Fisheries Organization.* Retrieved from: http://www.nafo.int/about/frames/convention.html.

NAFO. (2015). Report of the Fisheries Commission and its Subsidiary Body (STATIC) - 37th Annual Meeting FC DOC 15/23. *Northwest Atlantic Fisheries Organization*. Retrieved from: archive.nafo.int/open/fc/2015/fcdoc15-23.pdf.

NAFO. (2016). *NAFO Conservation and Enforcement Measures (NAFO/FC Doc. 16/1)*. Dartmouth: Northwest Atlantic Fisheries Organization.

NAFO. (n.d.). Introduction. *Northwest Atlantic Fisheries Organization.* Retrieved from: http://www.nafo.int/about/frames/convention.html.

NAFO. (n.d.). Risk-based Management Strategies. *Northwest Atlantic Fisheries Organization*. Retrieved from: http://www.nafo.int/fisheries/frames/precautionary.html.

NAFO SC. (2013). Report of the Scientific Council: Progress on the Roadmap to EAF. *Northwest Atlantic Fisheries Organization*. Retrieved from: http://archive.nafo.int/open/sc/203/scc/13-17.pdf.

NEAFC. (2015). Recommendation on Conservation of Sharks Caught in Association with Fisheries Managed by the North-East Atlantic Fisheries Commission: Recommendation 10:2015. *North-East Atlantic Fisheries Commission.* Retrieved from: http://www.neafc.org/managing_fisheries/measures/current.

NEAFC. (2016). Recommendation on Conservation and Management Measures for Basking Shark (Cetorhinus Maximus) in the NEAFC Convention Area for 2016-2019: Recommendation 8:2016. *North-East Atlantic Fisheries Commission.* Retrieved from: http://www.neafc.org/managing_fisheries/measures/current.

NEAFC. (2016). Recommendation on Conservation and Management Measures for Porbeagle (Lamna Nasus) in the NEAFC Regulatory Area from 2016-2019: Recommendation 7:2016. *North-East Atlantic Fisheries Commission.* Retrieved from: http://www.neafc.org/managing_fisheries/measures/current.

NOAA. (2013). International Efforts to Advance the Goals of the Shark Finning Prohibition Act. *NOAA.* Retrieved from: http://www.nmfs.noaa.gov/stories/2013/08/docs/rfmo_sharks_international_efforts.pdf.

Northwest Atlantic Fisheries Organization. (2004). *Convention on the Future Multilateral Cooperation in the Northwest Atlantic Fisheries*. NAFO: Nova Scotia.

Oceans and Law of the Sea United Nations. (2013). The United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (in force as from 11 December 2001) Overview. *Division for Ocean Affairs and Law of the Sea.* Retrieved from: http://www.un.org/depts/los/convention_agreements/convention_overview_fish_stocks.htm.

Osch, Stijn van. (2012). Save our Sharks: Using International Fisheries Law within RFMOs to Improve Shark Conservation and Management. *Michigan Journal of International Law*, 33, pp. 383-431.

Pew Environment Group. (2012). Navigating Global Shark Conservation: Current Measures and Gaps. *Pew Environment Group.*

Pinto, Daniela Diz Pereira. (2012). *Fisheries Management in Areas beyond National Jurisdiction: The Impact of Ecosystem Based Law Making.* Leidan: Brill.

Rice, Joel and Harley, Shelton. (2013). Updated Stock Assessment of Silky Sharks in the Western and Central Pacific Ocean. *Western and Central Pacific Fisheries Commission.* Retrieved from: https://www.wcpfc.int/sharks.

Rice, Joel, Shelton, Harley and Kai, Mikihiko. (2014). Stock assessment of Blue Shark in the North Pacific using Stock Synthesis. *Western and Central Pacific Fisheries Commission.* Retrieved from: https://www.wcpfc.int/sharks.

Robbins, WD, Hisana, M., Connolly, SR., and Choat, JH. (2006). Ongoing collapse of coral-reef shark populations. *Current Biology*, 16, pp. 2314-2319. Doi: 10.1016/j.cub.2006.09.044.

Roheim, Cathy and Sutinen, Jon. (2006). Trade and Marketplace Measures to Promote Sustainable Fishing Practices. Issue No 3, International Centre for Trade and Sustainable Development.

Roman-Verdesoto, Marlon and Hall, Martin. (2014). Updated Summary Regarding Hammerhead Sharks Caught in the Tuna Fisheries in the Eastern Pacific Ocean. *Inter-American Tropical Tuna Commission*. Retrieved from: https://www.iattc.org/PDFFiles2/StockAssessmentReports/SAR15/1-Hammerhead-shark-update.pdf.

Russell, Dawn. (2010). NAFO and ICCAT: The Implementation of Sustainability Principles and Practices in the Management of Straddling Stocks and Highly Migratory Species. In Dawn Russell and David VanderZwaag (Eds.), *Recasting Transboundary Fisheries Management Arrangements in Light of Sustainability Principles* (239-305). Leiden: Brill.

Russell, Dawn and VanderZwaag, David. (2010). Ecosystem and Precautionary Approaches to International Fisheries. In Dawn Russell and David VanderZwaag (Eds.), *Recasting Transboundary Fisheries Management Arrangements in Light of Sustainability Principles* (25-70). Leiden: Brill.

Russell, Dawn and VanderZwaag, David. (2010). The International Law and Policy Seascape Governing Transboundary Fisheries. In Dawn Russell and David VanderZwaag (Eds.), *Recasting Transboundary Fisheries Management Arrangements in Light of Sustainability Principles* (9-25). Leiden: Brill.

Schleit, Katie. (2015). New Path for Tuna Management and Protections for Porbeagle Sharks Agreed by International Tuna Body, Supported by Canada. *Ecology Action Centre*. Retrieved from: https://www.ecologyaction.ca/ICCAT2015release.

Shewchuk, Michael. [PDF Document]. *Developing and Ecosystems Approach*. Division for Ocean Affairs and the Law of the Sea – United Nations. Retrieved from: http://www.unep.org/NairobiConvention/docs/Michael%20Final%20EA%20Manual%20Module%20I%20Introduction%20to%20Ecosystems.pdf.

Simberloff, Daniel. (1998). Flagships, Umbrellas, and Keystones: Is single-species management passe in the landscape ear? *Biological Conservation,* 83, pp. 247-257. Doi: 10.1016/S0006-3207(97).

Simons, Henk, & van Menffont, Joost. (2015). The Importance of Ecosystems and the Ecosystem Approach. *IUCN*. Retrieved from: cmsdata.iucn.org/downloads/ecosystem_alliance_approach.pdf.

Speigel, J. (2001). Even Jaws deserves to keep his fins: Outlawing shark finning throughout global waters. *Boston College International and Comparative Law Review*, 24, pp. 409-438.

Staples, Derek & Funge-Smith, Simon. (2009). *Ecosystem approach to fisheries and aquaculture: Implementing the FAO Code of Conduct for Responsible Fisheries*. Bangkok: FAO Regional Office for Asia and the Pacific.

Stevens, J. 2009. *Prionace glauca*. The IUCN Red List of Threatened Species 2009: e.T39381A10222811. http://dx.doi.org/10.2305/IUCN.UK.2009-2.RLTS.T39381A10222811.en.

Stevens, J., Fowler, S.L., Soldo, A., McCord, M., Baum, J., Acuña, E., Domingo, A. & Francis, M. 2006. *Lamna nasus*. The IUCN Red List of Threatened Species 2006: e.T11200A3261697. http://dx.doi.org/10.2305/IUCN.UK.2006.RLTS.T11200A3261697.en.

Stevens, J.D., Bonfil, R., Dulvy, N.K., and Walker, P.A. (2000). The effects of fishing on sharks, rays, chimaeras (*chondrichthyans*), and the implications for marine ecosystems. *ICES Journal of Marine Science*, 57, 474-494. Doi: 10.1006/jmsc.2000.0724.

Szigeti, Peter & Lugten, Gail. (2015). The Implementation of Performance Review Reports by Regional Fishery Bodies, 2004-2014. Rome: Food and Agriculture Organization of the United Nations.

Tarasofsky, Richard, (2007). Enhancing the Effectiveness of Regional Fisheries Management Organizations through Trade and Market Measures. *Chatham House:* Energy, Environment and Development Program.

Techera, Erika, & Natalie Klein. (2010). Fragmented governance: Recruiting legal strategies for shark conservation and management. Marine Policy, 35, pp. 73-78. Doi: 10.1016/j.marpol.2010.08.003.

Techera, Erika. (2011). Good Environmental Governance: Overcoming Fragmentation in International Law for Shark Conservation and Management. Proceedings 105th Annual Meeting, 105, pp. 103-107. Doi: 10.5305/procannmeetasil.105.0103.

The Shark Research Institute. (2016). Shark Species. *The Shark Research Institute.* Retrieved from: http://www.sharks.org/about-sharks/species.

Timms, T. and Williams, C. (2009). Bleeding the Ocean Dry? The Overfishing and Decline of Global Shark Stocks. *WildAid*. http://www.wildaid.org/PDF/reports/2009%20shark%20report%20bleeding%20the%20oceans%20dry_english.pdf.

Townsend, David. (2012). *Oceanography and Marine Biology: An Introduction to Marine Science.* Maine: Sinaeur.

UNEP. (1992). Rio Declaration on Environment and Development. *United Nations Environment Programme.* Retrieved from: http://www.unep.org/documents.multilingual/default.asp?documentid=78&articleid=1163.

United Nations Environment Programme. (n.d.). Aichi Biodiversity Targets. *The Convention on Biological Diversity.* Retrieved from: https://www.cbd.int/sp/targets/.

United Nations General Assembly. (8 Sept., 1995). *Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.* A/CONF.164/37.

United Nations General Assembly. (10 March, 2006). Resolution adopted by the General Assembly on 29 November 2005: 60/30. *United Nations* A/RES/60/31.

United Nations General Assembly. (18, Dec., 2007). Resolution adopted by the General Assembly on December 18 2007: 62/117. *United Nations* A/RES/62/177.

United Nations General Assembly. (18, Dec., 2007). Resolution adopted by the General Assembly on December 18 2007: 62/117. *United Nations* A/RES/62/177

United Nations General Assembly. (6 July, 2015). Resolution adopted by the General Assembly on June 19 2015: 69/292. *United Nations* A/RES/69/292.

United Nations General Assembly. (7 Dec., 2010). Resolution adopted by the General Assembly on December 7 2010: 65/38. *United Nations* A/RES/65/38.

United Nations General Assembly. (8 Dec., 2015). Resolution adopted by the General Assembly on December 8 2015: 70/75. *United Nations* A/RES/70/75.

United Nations Treaty Collection. (2016). United Nations Convention on the Law of the Sea. *United Nations Treaty Collection.* Retrieved from: https://treaties.un.org/Pages/ViewDetailsIII.aspx?src=IND&mtdsg_no=XXI-6&chapter=21&Temp=mtdsg3&clang=_en#1.

United Nations Treaty Collection. (2016). Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA). *United Nations Treaty Collection.* Retrieved from: https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXI-7&chapter=21&clang=_en.

Vannuccini, S. (1999). *Shark Utilization, marketing, and trade.* Rome: The Food and Agriculture Organization of the United Nations.

Verlecar, X., Desai, S.S.R., & Dhargalkar, V.K. (2007). Shark hunting – an indiscriminate trade endangering elasmobranchs to extinction. *Current Science*, 98 (8), 1078-1082.

Watling, L., and Norse, E.A. (1998). Disturbance of the seabed by mobile fishing gear: a comparison to forest clear cutting. *Conservation Biology,* 12, pp. 1180-1197. Doi: 10.1046/j.1523-1739.1998.0120061180.x.

WCPFC. (2008). Conservation and Management Measure for Sharks: Measure 2008-04. *Western and Central Pacific Fisheries Commission.* Retrieved from: https://www.wcpfc.int/conservation-and-management-measures.

WCPFC. (2010). Conservation and Management Measure for Sharks: Measure 2010-07. *Western and Central Pacific Fisheries Commission.* Retrieved from: https://www.wcpfc.int/conservation-and-management-measures.

WCPFC. (2011). Conservation and Management Measure For Oceanic Whitetip Shark: Measure 2011-04. *Western and Central Pacific Fisheries Commission.* Retrieved from: https://www.wcpfc.int/conservation-and-management-measures.

WCPFC. (2012). Conservation and Management Measure for Protection of Whale Sharks from Purse Seine Fishing Operation: Measure 2012-04. *Western and Central Pacific Fisheries Commission.* Retrieved from: https://www.wcpfc.int/conservation-and-management-measures.

WCPFC. (2013). Conservation and Management Measure for Silky Sharks: Measure 2013-08. *Western and Central Pacific Fisheries Commission.* Retrieved from: https://www.wcpfc.int/conservation-and-management-measures.

WCPFC. (2014). Conservation and Management Measure for Sharks: Measure 2014-05. *Western and Central Pacific Fisheries Commission.* Retrieved from: https://www.wcpfc.int/conservation-and-management-measures.

Webster, D.G. (2009). *Adaptive Governance: The Dynamics of Atlantic Fisheries Management.* MIT Press: Cambridge.

Whitcraft, S., Hofford, A., Hilton, P., O'Malley, M., Jaiteh, V. and P. Knight. (2014). *Evidence of Declines in Shark Fin Demand, China*. WildAid. San Francisco: California.

Wirsing, A.J., Heithaus, M.R., and Dill, L.M. (2007). Living on the Edge: dugongs prefer to forage in microhabitats that allow escape from rather than avoidance of predators. *Animal Behavior,* 73, 93-101. Doi: 10.1016/j.anbehav.2006.11.016.

Worm, B., Davis, B., Kettemer, L., Ward-Paige, C., Chapman, D., Heithaus, M., Kessel, S., and Gruber, S. (2013). Global catches, exploitation rates and rebuilding options for sharks. *Marine Policy*, 40, pp. 194-204. Doi: 10.1016/j.marpol.2012.12.034.

WWF. (2016). Shark | Species. *The World Wildlife Fund*. Retrieved from: http://www.worldwildlife.org/species/shark.

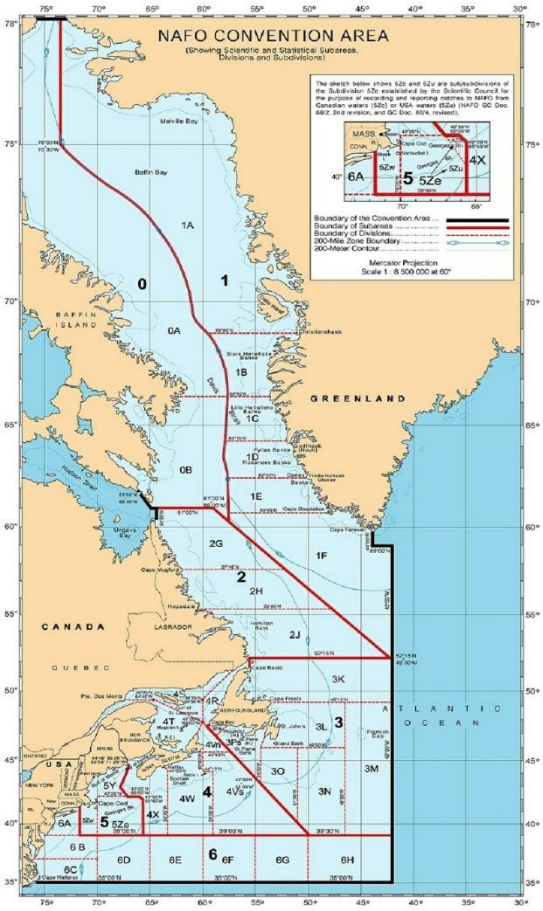
Appendix I – *IPOA Main Principles/Objectives*

The IPOA-Sharks recommends that the following 10 principles be applied in that decision:

1. Ensure that shark catches from directed and nondirected fisheries are sustainable.
2. Assess threats to shark populations, determine and protect critical habitats and implement harvesting strategies consistent with the principles of biological sustainability and rational long-term economic use.
3. Identify and provide special attention, in particular to vulnerable or threatened shark stocks.
4. Improve and develop frameworks for establishing and coordinating effective consultation involving all stakeholders in research, management and educational initiatives within and between States.
5. Minimize the unutilized incidental catches of sharks.
6. Contribute to the protection of biodiversity and ecosystem structure and function.
7. Minimize waste and discards from shark catches.
8. Encourage full use of dead sharks.
9. Facilitate improved species-specific catch and landings data and monitoring of shark catches.
10. Facilitate the identification and reporting of species-specific biological and trade data.

Source: Lack and Sant, 2011

Appendix II: *NAFO and ICCAT General Information*



(Source: nafo.int)

Northwest Atlantic Fisheries Organization (NAFO)

Date Established: 1979 – was a successor to ICNAF (International Commission of the Northwest Atlantic Fisheries, 1949-1978).

Contracting Parties: (12) Canada, Cuba, Denmark (in respect of Faroe Islands + Greenland), European Union, France, Iceland, Japan, Norway, Republic of Korea, Russian Federation, Ukraine, United States of America

Area of jurisdiction: Northwest Atlantic

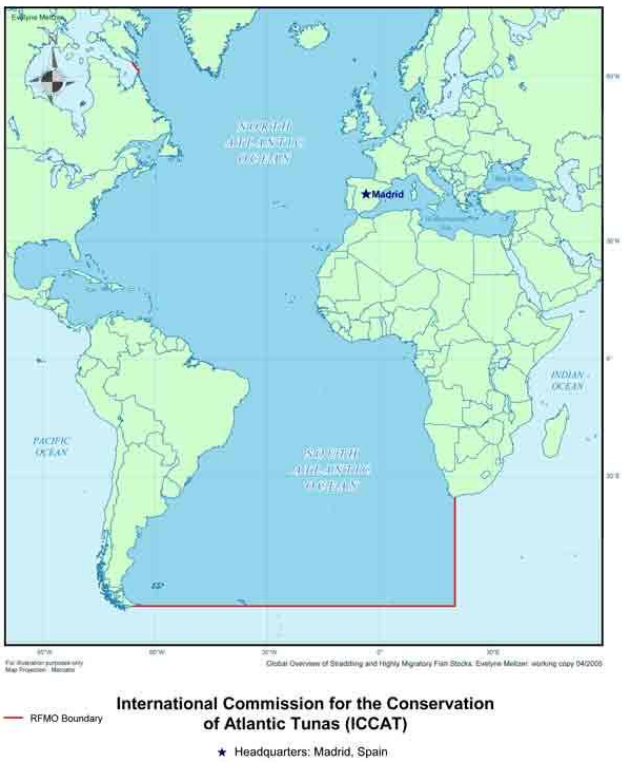
Size of jurisdiction: 6,551,289km2

Time of last performance review: 2011

Overlapping EEZs: USA, Canada, St. Pierre et Miquelon and Greenland

Number of Species: 11

Species: Cod, Redfish, American Plaice, Yellowtail, Witch, White hake, Capelin, Skates, Greenland halibut, Squid, Shrimp



International Commission on the Conservation of Atlantic Tuna (ICCAT)

Date Established: 1969

Contracting Parties: (50) United States, Japan, South Africa, Ghana, Canada, France (St-Pierre et Miquelon), Brazil, Maroc, Republic of Korea, Cote D'Ivoire, Angola, Russia, Gabon, Cap-Vert, Uruguay, Sao Tome e Principe, Venezuela, Guinea Equatorial, Guinee Republic, United Kingdom, Libya, People's Republic of China, European Union, Tunisia, Panama, Trinidad & Tobago, Namibia, Barbados, Honduras, Algerie, Mexico, Vanuatu, Iceland, Turkey, Philippines, Norway, Nicaragua, Guatemala, Senegal, Belize, Syria, St. Vincent & the Grenadines, Nigeria, Egypt, Albania, Sierra Leone, Mauritania, Curacao, Liberia, El Salvador

Area of jurisdiction: Atlantic Ocean

Size of jurisdiction: 98,087,612 km2

Time of last performance review: 2009

Overlapping EEZs: All contracting parties with EEZ's that lie within the Atlantic Ocean

Number of Species: 30

Managed Species: Common dolphinfish *(Coryphaena hippurus)*, Atlantic sailfish *(Istiophorus albicans)*, Wahoo *(Acanthocybium solandri)*, Bullet tuna *(Auxis rochei)*, Frigate tuna *(Auxis thazard)*, Little tunny *(Euthynnus alletteratus)*, Black skipjack *(Euthynnus lineatus)*, Skipjack tuna *(Katsuwonus pelamis)*, Plain bonito *(Orcynopsis unicolor)*, Atlantic bonito *(Sarda sarda)*, Serra Spanish mackerel *(Scomberomorus brasiliensis)*, King mackerel *(Scomberomorus cavalla)*, Atlantic Spanish mackerel *(Scomberomorus maculatus)*, Cero *(Scomberomorus regalis)*, West African Spanish mackerel *(Scomberomorus tritor)*, Yellowfin tuna *(Thunnus albacares)*, Blackfin tuna *(Thunnus atlanticus)*, Southern bluefin tuna *(Thunnus maccoyii)*, Bigeye tuna *(Thunnus obesus)*, Atlantic bluefin tuna *(Thunnus thynnus)*, Blue marlin *(Makaira nigricans)*, Atlantic white marlin *(Kajikia albida)*, Longbill spearfish *(Tetrapturus pfluegeri)*, Albacore *(Thunnus alalunga)*, Swordfish *(Xiphias gladius)*, Mackerels *(Scomberomorus)*, Porbeagle (Lamna nasus), Shortfin mako (Isurus oxyrinchus), Blue shark (Prionace glauca)

(Source: iccat.int)