

An Economic Analysis of Spiny Dogfish: Historical Trends, Future Markets, and Implications for Management Action

Prepared for:

Massachusetts Division of Marine Fisheries and its Seafood Marketing Program
Steering Committee

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Executive Summary

This analysis examines the history of global trade in spiny dogfish over the last 20 years to show changes in buyers and sellers, changes in price, the differences between key countries, and the differences between the frozen and fresh markets. To ground truth this data and expand upon the underlying market dynamics, we also present interviews of key dogfish stakeholders (processors and fishermen) to better understand determinants of price, constraints in the local supply chain (transportation, processing and harvesting), recommendations and advice for management, and directions for future work and market development.

Over the last 20 years, the US has become the major supplier of spiny dogfish to the EU; this includes both fresh and frozen supply, which are two separate markets. The US accounts over 90% of the global supply of dogfish, and the European Union represents over 90% of the global demand. The total exports of frozen dogfish have increased significantly since 2010, but total exports of fresh dogfish have been trending down since 2010, and now only represent about 25 percent of total sales (in 2001 fresh dogfish represented ~50% of total sales). Currently, the fresh dogfish market is supported primarily by two countries—France and Italy.

Prices of both fresh and frozen dogfish exports have been trending up over the last decade, with the price of fresh dogfish rising to an all time high in 2014-2016. Higher prices encourage more supply, but over supply of frozen dogfish in both 2011 and 2016 resulted in about 40% market correction 2012 and 2017. The ex-vessel price has remained relatively flat over the last 20 years, and has averaged around 18 -20 cents per lbs. Although spiny dogfish quota has significantly increased in recent years, according to interviewees, it is not the right time to increase trip limits. The net effect of increasing trip limits before new markets are created would be a dedicated effort by off-loaders and processors to slow fishing activity by telling boats they are not accepting fish on certain days, or significantly lowering ex-vessel price. The size of the market is currently constrained by the local processing capacity and the total maximum global demand, which was estimated at approximately 20 million lbs (whole fish).

Other changes to regulation, such as male only harvest for draggers were discussed, but would require significant upfront costs, management changes, and the development of entirely new markets to funnel supply. Regarding new markets, both fishermen and processor mentioned the interest in exploring government markets, such as prison systems or the military as potential outlets. Overall, there was more confidence that new markets would materialize here in the United States (as opposed to globally), given all the work that has been done marketing, promoting, and developing new value-added products with dogfish over the years. There might also be potential to improve existing fresh fish markets by changing to a weekly vessel limit over the course of the fresh fish season (Sept 1-April 30). This would allow vessels to increase harvests to coincide with the days that fresh fish is sold (Mondays and Fridays), and avoid days in the middle of the week when processors can't sell it, and instead, freeze it. It could also save operating and transportation costs for the vessel and off-loader if boats could catch more fish on fewer days.

INTRODUCTION:

This analysis is intended to inform the Massachusetts Division of Marine Fisheries and its Seafood Marketing Program Steering Committee about market trends and limitations affecting spiny dogfish fisheries. This information may be useful to DMF in its contributions to spiny dogfish management at the federal and interstate level. The Mid-Atlantic Council's Spiny Dogfish Advisory Panel (AP) annually addresses issues pertaining to overall quotas and daily trip limits.

This analysis concerns global market dynamics of Spiny dogfish over the last 20 years with focus on current markets and limitations. Specifically, we examine trends in export price and quantity (per lbs.) of both fresh and frozen dogfish products over time, discuss the relationship and differences between countries, evaluate the potential to recover lost markets or create new ones, and explain how management changes and changes in consumer preferences have impacted global trends. We use this information to draw conclusions about the maximum sustainable size of the global dogfish (export) market, and to make recommendations for future growth.

In addition to this analysis, we also interviewed key fishermen and processors of dogfish in New England² to better understand important questions raised by the Dogfish AP and the MAFMC over the last few years³, and to update the characterization of fishing communities involved in the spiny dogfish fishery. We were particularly interested in factors that influence prices and catch rates; the relationship between different regions (e.g. the seasonality of catch); the potential benefits and costs of proposed regulations (e.g. changes in trip limits, or male only harvest); the flow of product within the domestic supply chain (from vessel to truck to processor); the constraints and costs of processing; ways to increase domestic consumption and improve value added activities; and ideas for different research or management changes.

ANALYSIS OF GLOBAL CATCH AND TRADE IN SPINY DOGFISH

The main catches of spiny dogfish have historically been in the Northeast Atlantic and the Northwest Atlantic. Between 1950 and 1972, catch from the Northeast Atlantic (Norway, France, UK, Iceland) accounted for between 97 and 100% of the global reported catch (with a peak of 50,000 mt in 1972). Since that time the region's share has dramatically declined, especially over the last 20 years. By 2005, catch from that stock accounted for only 39% of the global catch, and by 2010 it accounted for just 7% of the global catch. Decades of overfishing in the Northeast Atlantic had reduced the spiny dogfish biomass by 95%⁴, and eventually in 2011, the EU Council followed the advice of the EU Commission and ended fishing completely for dogfish in the Northeast Atlantic (Council Regulation 57/11)⁵.

² Interviewees Included: Fishermen Doug Feeney; Fishermen; Fishermen Jamie Hayward; Processor Red's Best; Primary Processor Marder Trawling Inc.; Primary Processor Seatrade International; Secondary Processor Highliner.

³ 2017 Spiny Dogfish Advisory Panel (AP) Fishery Performance Report (FPR)
<https://static1.squarespace.com/static/511cdc7fe4b00307a2628ac6/t/59a6eb60893fc02cee00ad2c/1504111457029/2017-Dogfish-FPR.pdf>

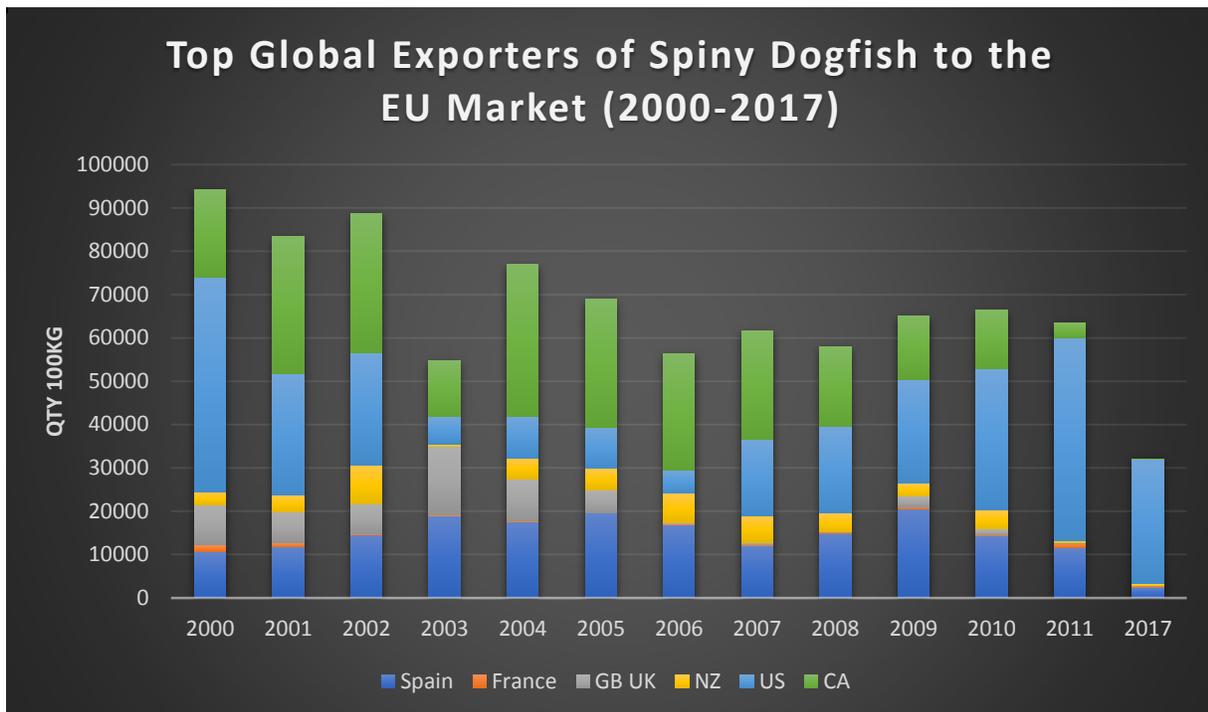
⁴ Lack, Mary 2006. CONSERVATION OF SPINY DOGFISH SQUALUS ACANTHIAS: A ROLE FOR CITES?

https://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/FINAL_Spiny_Dogfish_ImplementationRepDez06.pdf

⁵ Dell'Appa, A., J. Johnson, D. Kimmel., R. Rulifson. 2013. The international trade and fishery management of spiny dogfish: A social network analysis. *Journal of Ocean and Coastal Management*. (80)
https://www.researchgate.net/publication/267896648_International_Trade_in_Spiny_Dogfish_A_Network_Analysis_for_the_Fishery_Management

However, 95% of the global consumer market for spiny dogfish is in the EU. So, the decline of the European stocks meant opportunity for other regions to fill that void. In the 1990's, the United States stepped up to the plate, and rapidly expanded its domestic fishery. However, it didn't take long for the Northwest Atlantic stock of Spiny Dogfish to also become overfished. With the decline of more traditional groundfish resources in the late 80s and early 90s, the directed fishing for dogfish resulted in a nearly ten-fold increase in landings from 1987-2001. This led to a 75% decline in female spawning stock biomass, which prompted the Mid-Atlantic and New England Fishery Management Councils (Councils) to develop a fisheries management plan (FMP) for the species. With the FMP in place by 2002 (which included total allowable catch and strict trip limits), total US catch (and export) of Spiny Dogfish declined by 75% from 2000-2003.

Figure 1. Top Global Exporters of Spiny Dogfish (2000-2017)



(<http://epp.eurostat.ec.europa.eu/newxtweb/>)

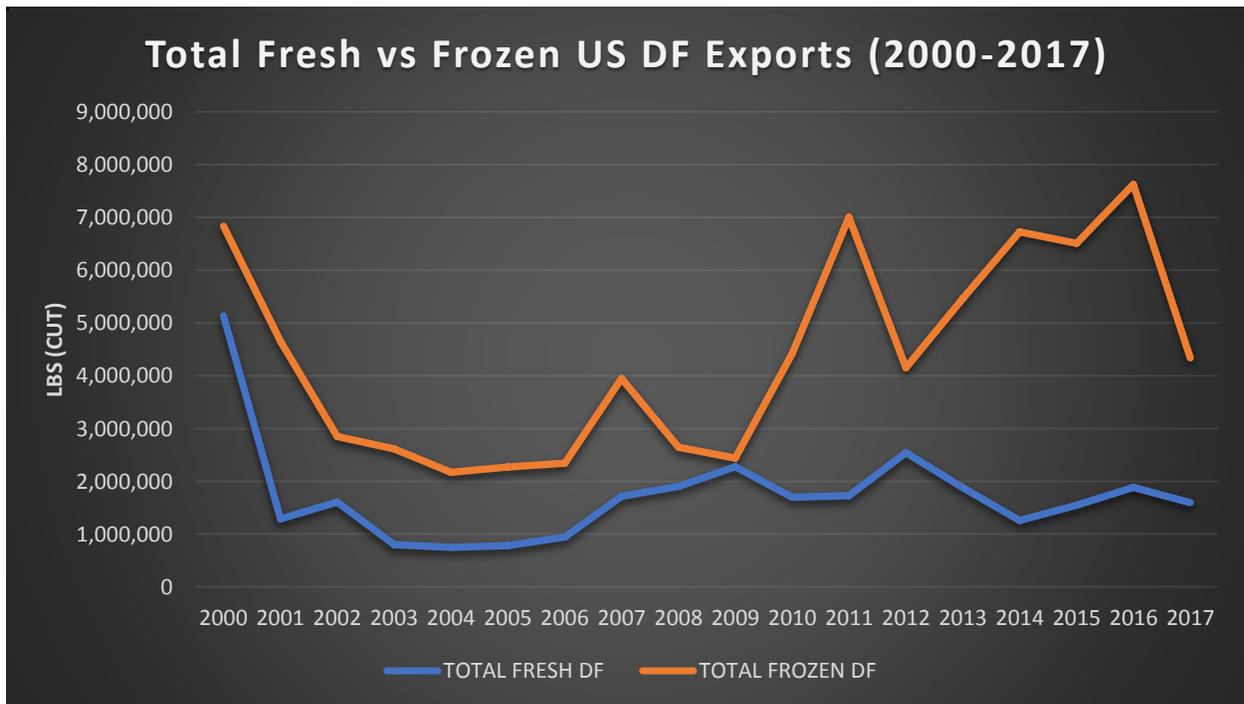
As **Figure 1** shows, between 2000-2002, the United States and Canada accounted for about 75% of all global exports to the EU. However, in 2003 when the FMP was put in place, US exports dropped by about 75% for the next five years, which once again provided opportunities for other countries to develop their fisheries. New countries increased their importance as exporters; particularly Canada and New Zealand. Also, amongst the EU27 countries, Spain became a central importer and exporter toward other west European countries (e.g. Portugal, Italy, France, and Greece) and several east European countries (e.g. Czech Republic, Poland, Bulgaria, and Slovenia). By 2010, the Northwest Atlantic spiny dogfish stock had fully recovered, and the United States regained control of most of the EU market. By 2017, the United States accounted for more than 90% of total global exports to the EU.

Market

Spiny dogfish product is known to be traded as fresh and frozen meat, including fillets; as tails; in smoked form; as fins; and as several by-products including cartilage and livers (or liver oil), hides, teeth and jaws. The 'back' represents the main body of the fish accounting for 28-30% of the total live body weight. Backs are exported for ultimate sale as fillets and steaks and for use in the fish and chips trade. 'Belly flaps' are produced during the dressing of the fish and are individually skinned and washed prior to freezing. The belly flap accounts for an additional 7% of the live weight (Personal Communication).

In the USA, the belly flaps are cut out, the fins removed, and the body is skinned leaving a white carcass or 'back' which is generally exported to Europe, particularly: France, Germany, Belgium, the UK, and Italy. Belly flaps are exported solely to Germany where they are smoked and used to prepare 'Schillerlocken'. Fins are frozen and exported to primarily to Thailand, where they are re-processed and re-distributed into the broader Asian market.

Figure 2. Total Fresh and Frozen US Spiny Dogfish Exports (2000-2017)



https://www.st.nmfs.noaa.gov/pls/webpls/FT_HELP_SPECIES

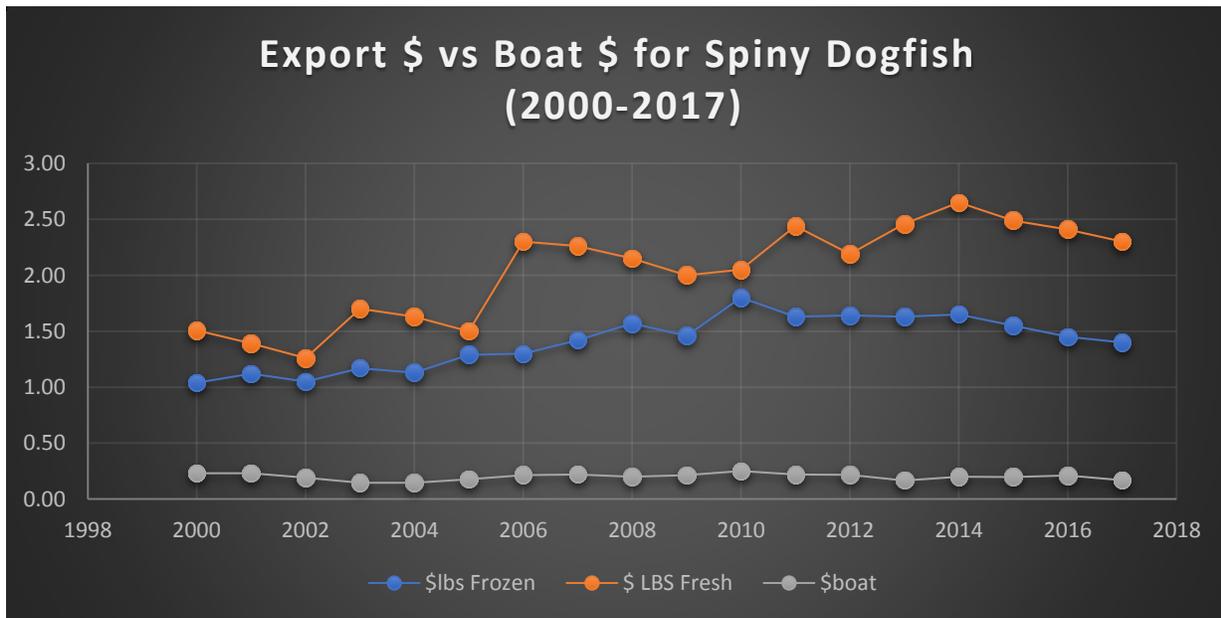
Figure 2 shows the relationship between the fresh and frozen spiny dogfish market over the last 17 years and illustrates the long-term trends in supply. As noted, US exports dropped considerably between 2000 and 2002 after the implementation of the FMP, and both frozen and fresh exports remained low until 2009. Up until this point, there also seemed to be a strong positive relationship between fresh and frozen supply, as they followed very similar trend lines. After 2009, the paths diverge considerably, and we start to see a significant increase in frozen dogfish exports. By 2016, the frozen exports were at their highest point in the last 20 years.

Meanwhile, fresh product showed a slight decline over this same period, and on average represented just 25% of the total dogfish export market (prior to 2009, the fresh market represented 50% or more of the total dogfish export each year). In 2012, we see a sharp decline in the fresh dogfish exports, which coincides with the EU concerns at that time about elevated PCB levels. However, this only seemed to impact the fresh market, as the frozen market increased sharply from 2012 all the way up until 2016, when it also crashed.

In the decade prior to 2016, the average export price (the price consumers are willing to pay) for frozen and fresh dogfish were both trending upwards. Over that same time, the total exports of frozen dogfish also increased sharply to take advantage of the higher price points (demand). Then, in 2016, the trip limit for dogfish increased to 6,000 lbs. per day, and according to processors and fishermen interviewed for this study, the domestic inventory became flooded with product (much of it ended up frozen), and the market crashed.

The quantity of US frozen dogfish exports fell by almost 40% from 2016 to 2017, and the export price of both fresh and frozen dogfish also declined. Together, the total US exports in 2016 was roughly 9.5 million lbs. of cut weight (at roughly 32% yield, this equates to about 28 million lbs. of whole dogfish quota). The consensus of both processors and fishermen interviewed for this analysis is that (for now) the global market for spiny dogfish can't support much more than 18-22 million lbs. of total catch (between 6-7 million lbs. of cut weight—backs, bellies and fins).

Figure 3. Export \$ for Fresh and Frozen Dogfish (2000-2017)



<http://epp.eurostat.ec.europa.eu/newxtweb/>; https://www.st.nmfs.noaa.gov/pls/webpls/FT_HELP.SPECIES

According to **Figure 3**, the average export price for both fresh and frozen dogfish has been trending up over the last 20 years. Two separate markets exist for fresh and frozen product, and the graph shows that on average, since 2010, the price for fresh dogfish is increasing and is about 40% higher than that of frozen dogfish. But, even as the fresh price has been increasing, the total exports of fresh dogfish have

fallen over this time. We would expect that higher prices would lead to increase production of fresh dogfish, but total exports (of fresh) have been trending down over the last 10 years even as prices have been trending up. Given the increases in quota and trip limits over the last ten years, it doesn't seem likely that significant constraints exist on the harvest of fresh dogfish. What's more likely is that the number of countries importing fresh dogfish has dropped. Countries who continue to buy fresh dogfish might be paying a little more for it, but by themselves, they can't make up for the loss of sales to other fresh dogfish markets.

Figure 4. US Global Export Market for Fresh Dogfish (2000-2017)



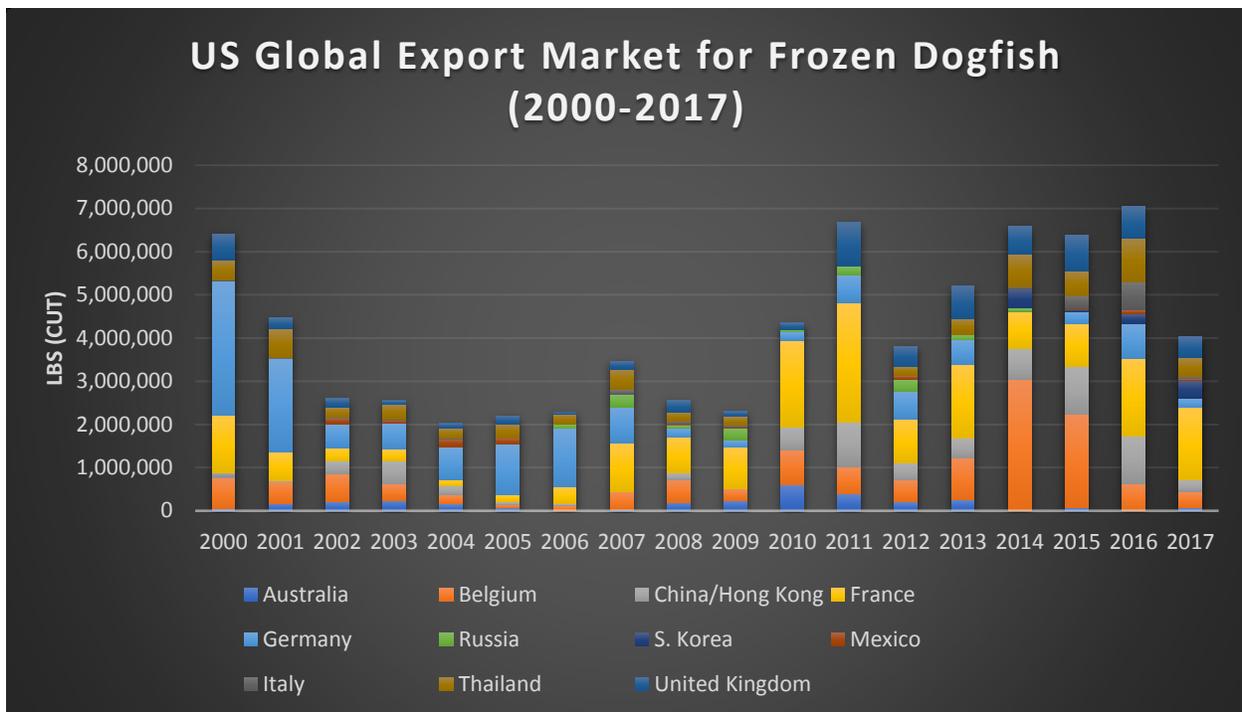
https://www.st.nmfs.noaa.gov/pls/webpls/FT_HELP.SPECIES

Figure 4 shows the change in the total US export market for fresh dogfish over the last 17 years. In 2000, prior to the implementation of the FMP, the fresh market for dogfish was about twice as high as it has been since then. In addition, in 2000, eight different countries purchased significant amounts of fresh dogfish. Exports slowed considerably between 2003-2008 while the fishery was rebuilding, but between 2009-2013, exports began to increase along with the diversity of the fresh fish market. However, ever since 2013, the diversity of the fresh dogfish market declined dramatically, and is now supported almost entirely by two countries: France and Italy (and to a much lesser extent, the UK).

It is unclear why the diversity of global buyers fell off so sharply, but again, the timing does coincide with the EU concerns about PCB in dogfish. In 2014 and 2015, France stopped purchasing fresh dogfish almost completely, and it was basically just Italy who supported the entire fresh market until 2016 when France came back in. In addition, over the last five years, there has been a concerted campaign led by EU politicians and environmental non-governmental organizations (ENGOS) to stop the sale and consumption of all shark species—including spiny dogfish. This appears to have had an impact of consumer preferences, and according to processors interviewed for this analysis, in countries like France, they stopped selling it in retail fish markets all together (to avoid labeling it as shark). The

primary markets that exist now for fresh are the prepared food markets, like restaurants, where species labeling is not as predominant.

Figure 5. US Global Export Market for Frozen Dogfish



https://www.st.nmfs.noaa.gov/pls/webpls/FT_HELP.SPECIES

The global market dynamics for frozen dogfish (**Figure 5**) tell a much different story than the markets for fresh dogfish. Most notably, the global export of frozen dogfish product has dramatically increased since 2010. There is also a much greater diversity of countries who purchase frozen product than fresh product; although, not all countries consistently buy it from year to year.

Prior to 2008, Germany was the largest global buyer of frozen product (this included both backs and belly flaps). But since 2008, it appears that Germany no longer purchases backs, and only purchases a small amount of belly flaps to prepare ‘Schillerlocken’. Other countries, like Russia, Mexico and China will purchase frozen dogfish for a few years in a row, and then stop all together.

Nowadays, the most consistent countries purchasing frozen dogfish are once again France and Italy. Belgium has also been a consistent buyer over the years, as has Australia, who purchases 2-300,000 lbs. of backs per year. And as discussed earlier, the (frozen) shark fin market is predominantly dominated by Thailand, although exports are also sent to Hong Kong for re-processing and distribution throughout Asia.

In 2017, the market for frozen dogfish crashed by roughly 40%, but it doesn’t appear this is a result of entire markets disappearing. Instead, the same diversity of countries bought frozen dogfish in 2017 as in 2016—the difference is that each country just purchased less. This puts frozen dogfish in a better

position to recover than fresh dogfish because at least the markets still exist. According to the processors interviewed for this analysis, once you lose the market, it is almost impossible to get back. This seems to be the case for now for the fresh market.

Summary of Global Trade Analysis

The Europeans developed a robust domestic market for spiny dogfish more than 80 years ago and sustained local demand primarily with local catch from Norway, Iceland, and the UK all the way up until the 1990s when the Northeast Atlantic stock began to decline. To meet EU demand, the northwest Atlantic stock was also severely depleted during the 1990s, but thanks to the world's first fishery management plan (FMP) for spiny dogfish developed by the NEFMC and MAFMC (and implemented in 2001) the stock was saved from collapse. Eventually, the FMP led to a massive rebuild of the northwest Atlantic stock, which positioned the United States to become the primary supplier of both fresh and frozen dogfish products to the EU and the rest of the world.

There are two primary dogfish products—fresh and frozen, which are characterized by significantly different prices, and a different mix of buyers. Over the last 10 years, the export price of both fresh and frozen dogfish has been increasing; however, only the frozen supply has significantly increased over this time frame. Frozen supply continued to increase until 2016, when the market significantly crashed due to oversupply—at this time, total exports equated to roughly 28 million lbs. of whole fish supply (quota). The combination of increased trip limits and new processors entering the market contributed to the oversupply.

Although fresh dogfish prices have been increasing over the last 10 years, the total supply of fresh product has been trending downward, and the number of global buyers has significantly declined. The entire fresh market is now mostly supported by two countries—France and Italy. It is unclear why the diversity of the fresh dogfish market has declined so dramatically, but it might be related to changes in consumer tastes and preferences—and to the overall shark conservation movement.

Still, historical data shows that alternative fresh markets have existed over the years in places like Latin America, China, and Belgium—which might present future opportunities for re-development. Based on the data, it is apparent that the fresh and frozen markets are entirely different; so, it could be possible to develop new fresh markets and increase the supply into those markets without negatively impacting the price or dynamics of the frozen markets. However, increasing the supply of frozen appears to be much more sensitive. In 2011 and in 2016, the total US exports of spiny dogfish exceeded 26 million lbs (whole weight), and both times the following year, the market crashed by roughly 40% (see Figure 3). Based on these analysis and interviews with processors and fishermen, until new markets are developed, the maximum sustainable size of the US export market is roughly 18-22 million lbs (whole weight) per year.

RESULTS OF INTERVIEW QUESTIONS

To better understand the market dynamics of spiny dogfish, especially as it relates to changes in management, we interviewed the four major processors (and exporters) of spiny dogfish in the United States—Marder Trawling, Seatrade, Highliner, and Red’s Best. We also received feedback on our interview questions from key industry participants Doug Feeney and Jamie Hayward, who spoke with us at length. To inform the management process, we developed a set of questions based primarily on comments and inquiries raised by the Dogfish AP in the 2016-2017 Dogfish Performance Reports. We also conducted an extensive literature review to derive additional questions and to validate answers of interviewees. To protect the confidentiality of interviewees, answers are grouped together under each question.

Questions for Processors and Fishermen

1. What are the biggest determinants of ex-vessel price for dogfish?

Ex-vessel price is primarily determined by the domestic processing capacity, the amount of inventory in the freezer, and the global demand of the European market. Prices are set by the processor to smooth landings over the course of the year so that daily processing capacity is not exceeded, and some scarcity remains in total inventory. Given the lack of global buyers, if buyers determine that freezer capacity is full, they will low ball export prices, and if processors hold out for a better price, they are at risk of losing the market altogether as buyers will readily substitute away from dogfish for another low value fish. This dynamic trickles back to the fishing vessel, and processors will continue to lower prices to the boat (off-loader) to slow fishing to clean out excess inventory.

As the number of processors increase, the risk of low ex-vessel prices also increases. For example, two years ago, there were four major processors, and a global market that could support ~20 million lbs. However, with an increase in daily trip limit to 6,000 lbs, the fishery landed about 28 million lbs., and inventory for all four major processors were exceeded. The global buyers had significant leverage in this situation, prices fell, and vessels were shut down by the off loaders in the major ports in New Hampshire, Massachusetts, Rhode Island, New Jersey, and Virginia. In 2018, the number of major processors has dropped back down from four to two, which has constrained total inventory and the daily processing capacity. This leaves some excess demand from global buyers, which should have a positive impact on prices and allows vessels to continue to fish.

2. What is the seasonality of dogfish landings across regions (fishing communities)?

The dogfish fishery is a seasonal fishery, which follows the migration of the larger female schools of fish from New England to Virginia. Starting in June, the dogfish begin to show up in waters of New England, and fishermen begin fishing for it heavily in July through October. By November, the schools have moved south to Rhode Island and make it to New Jersey by December. From there, they continue to migrate south to Virginia in January and February, and by March and April they have begun to migrate north again and can be found off the coast of New Jersey again. Eventually, they make their way back up north in May through June and the cycle repeats.

3. What is the relationship/difference between the fresh and frozen dogfish markets?

As shown in the trade data analysis, the fresh and frozen markets are completely different markets with significantly different price points. On average, the export price of frozen product has been roughly \$1.50 per lbs, and the export price of fresh product has been around \$2.25. At these prices, processors only make any real money from the fresh product. However, the fresh market doesn't exist until Sept 1, and then lasts throughout the winter months until April.

Most of the dogfish caught by New Hampshire and Massachusetts vessels occurs over the summer, especially during the months of July and August, where fishermen can declare out of the ground fish fishery and declare into the exempted dogfish fishery (where they can target dogfish without having to be on a sector trip). Almost all this dogfish is frozen.

Developing a summer fresh dogfish market would be hard, for a few reasons. First, European demand drops significantly for all fish in the summertime, and most Europeans tend to take the entire month of August off (including the European buyers). Second, it would require an extra investment by the vessel to carry more ice for the dogfish, which is hard to justify at the very low ex-vessel price. Finally, dogfish are highly perishable, even when packed for shipment, marginal increases in temperature that can occur during transport (like waiting on the Tarmac at the airport) significantly impact the quality of the dogfish product. Each year, processors expect a certain loss from spoiled dogfish, even during the fall/winter months.

Although some of the fresh market is supplied by Massachusetts and New Hampshire vessels in September and October, most of the fresh fish market is supplied by mid-Atlantic vessels from Rhode Island to Virginia. Even though processors make significantly more money from fresh dogfish than frozen dogfish, the ex-vessel price to the vessel/off-loader doesn't change—in fact, northern vessels on average make more money per lbs. than southern vessels (fresh fish vessels) because the increased transportation cost to ship the fish from the mid-Atlantic region to New England comes off the top of the price per lbs. processors pay off-loaders.

On average, this year, northern vessels are making 18-22 cents per lbs., and southern vessels are making 14-16 cents per lbs. Processors pay around 32 cents per lbs to the off-loader. In the mid-Atlantic, 12 cents per lbs comes off the top for transportation, 5-6 cents per lbs goes to the offloader, and the remaining 14-16 cents per lbs goes to the vessel. In New England, the proximity to processors reduces transportation costs, and results in less money coming off the top and higher prices to the vessels.

Processors can't pay differentially more for fresh fish than frozen fish because it is uncertain ahead of time how much of the fresh catch can be sold into the fresh market, and if it can't be sold into the fresh market, if it will be frozen and added to the frozen inventory. The frozen market is based on pennies and there is no guarantee that these pennies will be positive, so processors rely on profits from the fresh market to make money. Because the fresh and frozen products are intermingled at the processor level, the prices paid to the vessel are based an average of the revenue from both fresh and frozen products.

4. Would you support an increase in the daily trip limit for dogfish?

The consensus amongst all processors and fishermen interviewed was that an increase in the daily trip limit would not result in more money to the boat. Because capacity to process dogfish is constrained (120k per day), and over supply of frozen inventory can quickly lead to low-ball prices from global buyers, the net effect of increasing trip limits at this time would be a dedicated effort by off-loaders and processors to slow fishing activity by telling boats they are not accepting fish on certain days. According to all processors interviewed for this analysis, the dogfish markets are slowly recovering this year, but an increase in trip limits at this time could seriously jeopardize the progress being made to bring the markets back.

5. Would you support a 'male only' winter harvest by draggers?

In general, both processors and fishermen had concerns about the viability and market effects of a directed male dogfish fishery over the winter. In the end, both agreed that the only way this would work is if an entirely new market was developed first—where the smaller (lower dragger quality) males could be sold. None of the processors currently accept dragger dogfish due to the lower quality, and because the males are significantly smaller, the processing costs for males would be significantly higher. One processor mentioned that if a new market could be found to accept the males, the only way it would work from a processing standpoint is by developing an automatic cutting machine. However, utilizing such a machine for small males would destroy the belly flaps, and reduce the overall price of the dogfish product. Therefore, the price paid to the boat would be significantly less (12-14 cents per lbs.), and any new market that was created would have to be large enough, so it became a pure volume fishery. In this way, draggers could target as much fish as they could each trip (no trip limits) and make more money the more fish they caught. From an ecosystem perspective, this idea was interesting just to get the dogfish out of the ocean. But there are significant upfront costs, potential market risks, and regulatory changes that would need to occur to make this a viable option.

6. What are the chances that new markets for dogfish can be developed, or old markets re-developed?

The consensus among both processors and fishermen matched what the US export data showed, that the European markets for dogfish have changed significantly over the past 10 years, especially for the fresh market, and due to changing consumer tastes and preferences (and negative 'shark' PR), these fresh markets will be difficult to recapture—many fish markets and grocery stores in Europe won't display 'shark' products anymore. For the frozen market, there is a greater diversity of buyers and the potential for continued growth (see **Figure 2**). This might be because it is more versatile and can be used for more (behind the scenes) prepared products.

As the data shows, significant attempts have been made over the years to develop new markets in places like China, Russia, and Latin America—but these markets have not been sustainable. For example, both fishermen and processors interviewed have made large efforts in China, in particular. However, everyone came to the same conclusion—although the Chinese eat a lot fish, they still seem to not really like the dogfish product. Efforts are continuing in some of these places, and there is optimism that global markets could still materialize under the right conditions (and with continued exposure to the product, or to new value-added products). Part of the evolution could come about when the older generation of global buyers give way to a younger generation of buyers who have less experience with dogfish and are willing to learn more about it and take chances on this MSC certified product.

Still, everyone interviewed agreed that the highest likelihood of new markets is right here in the United States. Significant efforts have been made over the last ten years to increase awareness and change tastes and preferences for dogfish. For example, local universities are now purchasing a few hundred thousand lbs. per year, CSF programs (like New Hampshire Community Seafood) are offering dogfish as part of the rotation of fish to both consumer and restaurants, and multiple grants have been awarded to groups (especially on the Cape) to develop new value-added products with dogfish.

According to fishermen and processors interviewed, turning dogfish into value-added products could have the most significant impact on developing new long-term sustainable markets. Fishermen on the Cape have done the most work developing these markets, and over the last 10 years have received multiple federal grants for these purposes. The newly formed, Chatham Harvester Group is working with processors via 2-million-dollar grant from the USDA to develop multiple products, including: a fish burger, fish sticks, and fish nuggets. There is optimism that these products could form the basis of entirely new markets and increase prices that could trickle back to the boat.

In addition to value added products, all processors and fishermen also mentioned the potential for working directly with the prison system or the Defense Department to establish long-term contracts for dogfish purchases. Even though these avenues seem like logical options to explore, no one interviewed is aware of any work being done to develop these markets. It would probably take the efforts of a dedicated lobbyist, or marketing professional working full time (along with financial support, like another grant project).

7. Do you have any ideas for management changes that could improve the dogfish markets?

Most interviewees thought that there was no need to change any management regulations at this time. However, one respondent suggested an option that might make sense for the southern boats and the fresh market. Currently, processors send trucks down south to pick up fish three times a week— Monday, Wednesday and Friday. They do so because the daily trip limit forces fishermen to fish all week long to maximize landings. However, processors can only take product for the fresh market on Monday's and Fridays. This means that almost all fish that gets shipped up on Wednesday is put directly into the frozen inventory, which could lead to over-capacity in the freezer, overall lower prices and risk of market collapse. However, according to the processors interviewed if they had more fresh product on Mondays and Fridays, they could almost certainly sell it. The existing trip limits constrain boats from catching significantly more on Mondays and Fridays, but if there was a way to modify trip limits – either through regulation or informally dealer-imposed differential daily limits that might be accommodated through a flexible weekly limit regulation – on those days, fishermen and processors might be able to make more money.

One option for doing this is to go to a seasonal weekly trip limit during the fall-winter period (October-April) when catches are more variable due to weather and the Mid-Atlantic ports see most of the landings. This would allow fishermen to focus their efforts to load up the trucks on Monday and Friday and would likely allow them to save a trip or two in the middle of the week (saving fuel costs and other operating expenses). For processors, they save money only having to send a truck two days a week. And by receiving more fresh fish on Mondays and Fridays, they could more consistently fill orders, and potentially grow new markets for fresh fish. Because processors make more money selling fresh fish, profits should increase. And less 'winter harvest' dogfish going into the frozen inventory helps to keep frozen fish prices stable, and potentially increase, due to increase scarcity.

KEY OUTCOMES AND NEXT STEPS

- The global market for spiny dogfish is still the EU, with frozen dogfish representing 75 percent of all sales. Frozen dogfish also has a greater diversity of global buyers than fresh dogfish, and total exports have been increasing over the last 10 years—as opposed to exports of fresh dogfish, which has been trending down over the last 10 years.
- The total size of the global market for spiny dogfish is estimated at around 20 million lbs. (whole fish); and it appears that if exports increase significantly past this breaking point, the frozen market crashes (as it did in 2012 and 2017).
- The cost of processing dogfish is very expensive and requires specialized cutters. This constrains daily processing capacity to roughly 120,000 lbs per day for the major processors. If new markets were developed, it might be worth exploring the use of automatic cutting machines to reduce costs and increase capacity.
- Given the constraints of global demand and processing costs, an increase in trip limits at this time will likely lead to lower prices to the boat and time off the water.
- The biggest opportunities for new markets are likely here in the United States through prepared foods, or continued expansion to the ‘local’ food markets; especially schools, hospitals and CSFs.
- Management changes to allow a ‘male only’ harvest for draggers over the winter season would require significant upfront investment to develop new markets, testing of new methods of cutting (automated), and would necessitate significant flexibility in daily catch limits.
- The ‘fresh’ dogfish season doesn’t really start until October (when the temperature outside drops) and runs through April; and most fresh dogfish is supplied by Mid-Atlantic vessels. Anything that doesn’t sell into the ‘fresh’ market during this period is frozen and adds to the frozen inventory accumulated over the summer.
- There might be opportunity to increase sales to the fresh market without negatively impacting the frozen market by moving to a seasonal ‘weekly’ vessel limit. By coordinating with processors, fishermen might be able to prioritize harvest (land more) for Mondays and Fridays to coincide with the days of the week that processors sell fresh dogfish.

Next Steps

- Explore the potential for developing new government and institutional markets, like military and prisons.
- Explore the potential size and scope of new value-added markets, and determine key questions:
 - Who is developing these markets (e.g. Highliner, US Foods, Reds Best, Chatham Harvesters Group)?
 - Would higher prices for value added products trickle down to the fishermen?
 - Would new value-added markets significantly increase the amount of potential harvest?
 - Would management regulations need to change to accommodate?
- Explore the historical use/future development of automatic cutting machines, and determine benefits and costs, including the potential to reduce processing costs and increase capacity to meet future value-added markets.
- Explore the benefits and costs of new fish handling and sorting techniques on the vessel, including: pre-processing and icing and bleeding. Compare shelf life and product characteristics (smell, taste, look) of pre-processed/pre-bled product to traditional product that has not been pre-processed.

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