

Advancing Traceability in the Seafood Industry

ASSESSING CHALLENGES AND OPPORTUNITIES



JANUARY 2017

**FISH
WISE** 

About FishWise

FishWise, founded in 2002, is a non-profit marine conservation organization based in Santa Cruz, California. FishWise promotes the health and recovery of ocean ecosystems by providing innovative market-based tools to the seafood industry. The organization supports seafood sustainability through environmentally and socially responsible business practices. FishWise is a founding member of the Conservation Alliance for Seafood Solutions, with staff serving on the External Stakeholder Advisory group for the Seafood Task Force, Environmental Stakeholder Committee of the International Seafood Sustainability Foundation (ISSF), the Fisheries Advisory Council of Fair Trade USA, and participates in a variety of other industry and marine conservation initiatives. FishWise works with companies throughout the supply chain and is currently partnered with several of North America's largest retailers, including Albertsons Co., Target Corp., and Hy-Vee Inc. Through its relationships with retailers and suppliers, FishWise works with over 120 million pounds of seafood per year and more than 100 species from farmed and wild sources. FishWise's retail partners maintain more than 4,500 storefronts in North America.

For more information about FishWise, see: www.fishwise.org.

About this Document

The first version of this white paper was released in May of 2012, with the first revision following in August 2012. Since that time, further engagement with seafood stakeholders and additional research informed this third, revised and expanded white paper. It is hoped that this document will create connections across businesses, organizations, and governments to spark conversation and action as to how the seafood stakeholders can collaborate to help improve seafood traceability and eliminate human rights abuses and illegal products from supply chains.

It should be noted that, while the majority of facts presented in this document have been reviewed with their sources, this paper has not been formally peer-reviewed and should only be used for guidance and informational purposes. Additionally, this document is not exhaustive - not all initiatives and groups are included.

Additional resources can be found at the end of this document, including links, contact information for the organizations mentioned, and full citations for referenced documents.

This version of the report should be cited as:

FishWise (2017) *Advancing Traceability in the Seafood Industry: Assessing Challenges and Opportunities*. <https://www.fishwise.org/traceability/traceability-white-paper/>

©2017 FishWise. All rights reserved. Sections of this report may be copied with permission of FishWise. Please acknowledge source on all reproduced materials.

Table of Contents

Executive Summary	1
Introduction	2
What is Seafood Traceability?	3
Current Landscape	10
Current Players	21
Recommendations for Supply Chains	26
Emerging Issues	29
Conclusion	30
Acknowledgements	32
Appendix I. Organizations Working in Seafood Traceability	35
Appendix II. Resources on Traceability	55
Appendix III. Contacts	59
Appendix IV. Works Cited	68

Table of Figures

Figure 1: Simplified Diagram of Seafood Supply Chains	4
Figure 2: NOAA's 2015 Report to Congress.....	16
Figure 3: Recommended Next Steps for Seafood Businesses Seeking to Improve Traceability.....	25

Executive Summary

Advancing Traceability in the Seafood Industry

This white paper aims to serve as a tool to help conservation NGOs, traceability experts, and industry join forces to improve seafood traceability. It also seeks to provide businesses with background information on traceability in seafood, as well as resources businesses can utilize to plan and implement traceability and anti-IUU fishing protocols within their supply chains.

This paper summarizes the seafood traceability landscape, including current challenges, a discussion of international and regional governance, and steps that seafood businesses can take to improve the traceability of seafood within their supply chains. It concludes with information about some of the key conservation organizations, for-profit companies, certifications, and other players currently working to support the adoption of end-to-end, electronic, interoperable traceability in the North American market.

THE MAIN FINDINGS OF THIS REPORT ARE:

- Seafood supply chains are often complex and, historically, information within supply chains has been closely guarded.
- Improving traceability within supply chains can help identify and mitigate risks such as food safety concerns; mislabeling and fraud; illegal, unreported, and unregulated (IUU) fishing; and human rights and labor abuses.
- Traceability can also be used to track progress towards a company's seafood sustainability commitment and help them communicate a product's 'story' to consumers.
- Challenges exist for achieving end-to-end, electronic, interoperable traceability throughout global seafood supply chains including: language and technological barriers, varying sizes and scales of supply chains, limited capacity and resources within companies, differing national-level traceability requirements, concerns over information sharing and confidentiality, and the need for improved alignment on key data elements (KDEs).
- Many resources exist for businesses looking for actionable steps to improve traceability, and there are a range of initiatives currently underway.
- The most important areas of focus in the coming years will include: aligning on Key Data Elements, ensuring claims and data are verified, and improving information technology systems.
- Investing resources into traceability improvements now will help companies protect brand value, build consumer trust, identify areas of risk in supply chains, and demonstrate leadership in this growing field.



Introduction

The occurrence and implications of illegal harvesting of seafood and the mislabeling of seafood products have become more prominent in recent years due to increased media attention and the efforts of industry, nongovernmental organizations (NGOs), and governments to combat these problems. Additionally, egregious human rights abuses - like human trafficking and forced labor - have been documented in some seafood supply chains. Opportunities for fraud, such as knowingly mislabeling species name or catch method, are also increasing as new fisheries are developed and supply chains become more complex.

Increasingly, companies are publicly committing to sustainable seafood sourcing policies, and the challenge is now for those companies to be able to track the origin of their products to ensure that species and attributes of the products are meeting their policies and communicated to the customer accurately. For companies that buy and sell seafood, the lack of product origin information and supply chain transparency can pose significant risks. In the past, industry's traceability focus was primarily on food safety concerns. However, the increase in media coverage about the environmental, social, and legal issues associated with seafood has led to significant shareholder concerns, potential impacts on brand value, and challenges to the corporate social responsibility initiatives of companies. The recent attention to the topic also creates an opportunity for companies with full traceability to actively promote the many benefits of their products, such as social and fair trade compliance and engagement in fishery improvements.

The first step towards mitigating and eventually eliminating these risks is to ensure end-to-end, electronic, interoperable traceability systems are in place throughout the supply chain. This work is already underway with some companies that are instituting traceability policies and setting goals, often with the assistance of NGOs, government bodies, and technology companies. However, there is much more work that needs to be done.

What is Seafood Traceability?

Definitions

Traceability is defined as the ability to systematically identify a unit of production, track its location, and describe any treatments or transformations at all stages of production, processing, and distribution (Magera and Beaton 2009). It is achieved through proper documentation and record keeping, along with proper handling protocols during processing, shipping, and receiving, to ensure that product can be tracked accurately. For seafood, end-to-end traceability also implies that a consumer unit of seafood at a restaurant or retailer can be traced throughout the supply chain back to its point of harvest by a vessel or on a farm (see example of seafood supply chains Figure 1 (Future of Fish 2016a)). Traceability is key to identifying product origins and the chain of custody for the product. The data collected can also be used to inform protocols and expectations to verify food safety, legality, and sustainability.

Electronic traceability systems use electronic means such as computerized or cloud-based databases, barcodes, software solutions, or other tools to capture and record product traceability information (Future of Fish et al. 2016). Increasingly, these tools are replacing paper-based documentation systems.

Interoperability is the ability of information technology or software systems or to exchange information with different traceability systems. Interoperable traceability systems enable members of supply chains to share and use information more readily. To be fully interoperable systems must be able to utilize a common data format (syntactic interoperability) and they must interpret information based on shared definitions (semantic interoperability) (Future of Fish et al. 2016).

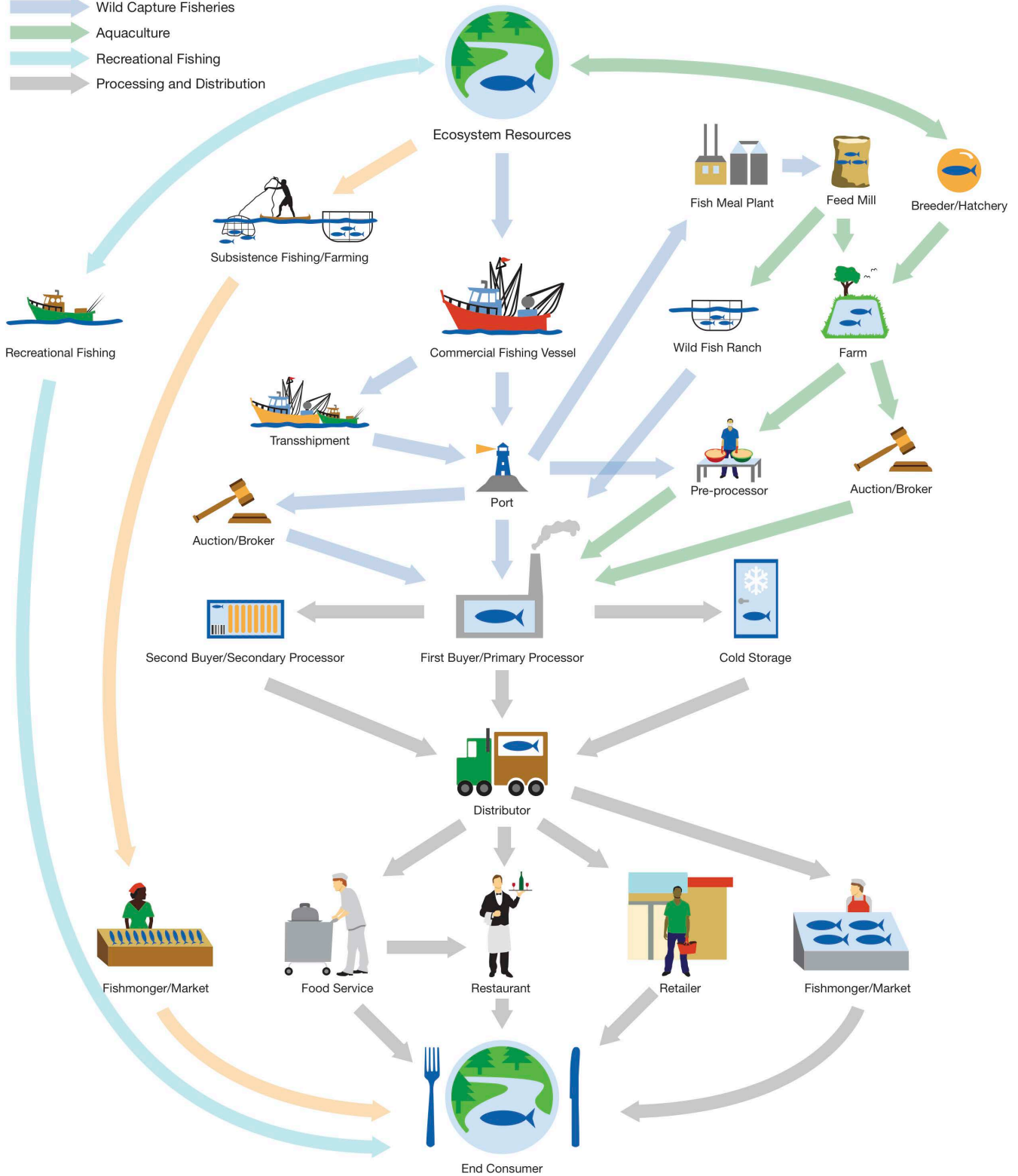
For definitions of other key traceability terms, please see the [Seafood Traceability Glossary](#) (Future of Fish et al. 2016).

When shared, information about where seafood came from, who caught it, how it was caught, and how it was handled or processed can support efforts to detect and deter illegal, unreported, and unregulated (IUU) fishing, seafood fraud, labor abuse, overfishing, and support a range of other business functions. Therefore, the ultimate goal is to have end-to-end, electronic, interoperable traceability in place throughout global seafood supply chains.

Figure 1: Simplified Diagram of Seafood Supply Chains

Key:

-  Subsistence Fishing/Farming
-  Wild Capture Fisheries
-  Aquaculture
-  Recreational Fishing
-  Processing and Distribution



Background

Early concern over the origin of animal products is documented as far back at the 14th century during the major epidemics of human plague (Blancou 2001). As early as the 18th century, human and livestock diseases in Europe brought about requirements for documentation when importing or exporting animals, quarantine processes before slaughter, and strict standards for slaughtering animals known to be infected (Blancou 2001).

In 1906, public pressure in the U.S. over the sanitary conditions of slaughterhouses and packing plants led Congress to pass the Federal Meat Inspection Act (FMIA). The FMIA requires “one up, one down” recordkeeping for in-country beef products - meaning that records about the source and attributes of the product must be provided by the supplier to the recipient of the beef. Further, under FMIA imports must be accompanied by a record of country of origin and plant of origin, along with proof that the products passed both USDA and customs requirements (FDA 1906). These requirements constituted some of the first nationwide food traceability regulations in the U.S.

It was not until 1991, that the U.S. Food and Drug Administration (FDA) established the Office of Seafood and increased funding for seafood inspection (Foulke 1993). After testing seafood for 10 years (1988-1997), the National Seafood Inspection Laboratory issued a press release indicating that 37% of fish and 13% of other seafood were labeled incorrectly (Tennyson et al. 1997).

In 1994, a rigorous definition of food supply chains was provided by the International Organization for Standardization and supported by EU Regulation 178/2002. This defines traceability as “the ability to trace and follow a food, feed, food producing animal [or ingredients], through all stages of production, processing and distribution” (EU Regulation 178/2002). Only in this past decade — with developments in global markets, food recalls, and potential acts of bioterrorism — has traceability become an important issue affecting the entire food supply chain.

The U.S. Farm Security and Rural Investment Act of 2002 requires “country of origin” labeling (COOL) on all muscle cut and ground lamb, goat, and chicken, wild and farm-raised fish and shellfish, fresh and frozen fruits and vegetables, peanuts, pecans, macadamia nuts, and ginseng by retailers (fish markets, exporters and food service establishments were excluded; USDA 2012). For fish and shellfish, a designation of wild or farmed was also required. The COOL labeling requirements does not apply to processed food items (fish sticks, cooked product, etc.). In the same year, the U.S. Bioterrorism and Response Act of 2002 required the registration of all food facilities, domestic and foreign, supplying food to the United States. It addition, it mandates records to identify the suppliers and recipients of all food products (FDA, Bioterrorism Act of 2002).

New technologies have emerged to assist in food traceability. For instance, barcodes which have been widely used in consumer-packaged goods since the 1970s, have in the last couple of decades incorporated expanded information about the company, product, and origin of food products using 14 digit UPC codes (Uniform Code Council 2003).

Food Traceability in the EU

In 2002, in part due to outbreaks like that of foot-and-mouth disease, the European Union's General Food Law (Regulation 178/2002, Article 18) came into force requiring compulsory traceability for food and feed operators. EU Article 4, regulation 104/2000, also came into effect in 2002, mandating that all fishery products be labeled with commercial designation of the species, the production method (if farm raised), and the catch area or production location. European Community Commission Regulation 2065/2001, Article 8, pertains to detailed provisions for the application of EU regulation 104/2000 and requires that all chilled, frozen, smoked fish or fillets, and shellfish, when offered for retail sale, be labeled in accordance with EU 104/2000. In addition to these requirements, this information must be provided at each stage of the marketing chain, either by direct labeling or acceptable commercial documentation. In 2004, TRACES (Trade Control and Expert System) was implemented to control import and export of live animals and animal products to the EU.

Importance

If seafood is not fully traceable it is difficult to recall a product lot when it is found to be unsafe to eat, impossible to prove it is from legal sources, is accurately labeled, from sources that meet social and human rights standards, or meets the sustainable sourcing commitment of a company. Companies that lack the proper traceability documentation and protocols throughout their supply chains are at legal and reputational risk. However, it is not only risk avoidance that makes traceability important. The recent attention to these topics by the media creates an opportunity for companies with end-to-end traceability to actively promote their products unique attributes such as social and fair trade compliance and engaging in credible fishery and aquaculture improvement projects.

Food Safety

Seafood, when not properly handled or from tainted waters, can cause many foodborne illnesses. From 2003-2008, the CDC estimates that finfish were the 8th highest in single food commodity outbreak occurrences, and mollusks were 11th (CDC 2011). In 2010, the Gulf Oil Spill caused significant concerns about food safety (CDC 2010). Traceability and the ability to communicate testing results became key to ensuring confidence in the seafood market from the region. This inspired an expedited launch of the then piloting Gulf Wild® testing and tracking program (developed by Environmental Defense Fund and the Gulf of Mexico Reef Fish Shareholders' Alliance), which discloses the general harvesting fishermen, vessels and locations for participating Gulf finfish.

Mislabeling and Fraud

Fish, one of the most traded food commodities, was estimated at a first-sale value of \$129.2 billion for capture fisheries (FAO 2012a) and \$160.2 billion for aquaculture production globally (FAO 2016a). This valuable commodity is sometimes fraudulently sold; investigations by Consumer Reports (2011) and the Boston Globe (2011) have reported mislabeling rates in seafood as great as 20% and 48%, respectively. A Food and Drug Administration (FDA) investigation from 2012-2013 revealed a 15% mislabeling rate among seafood products tested at the wholesale level (FDA 2014). Further, an Oceana (2016) investigation of species at high risk of mislabeling found that one in five of more than 25,000 samples of seafood tested worldwide were mislabeled. Mislabeling was found to have occurred in several different types of companies - retail stores, restaurants, sushi bars, and others (Oceana 2016). Examples of species mislabeling around the globe include: 82% of grouper, perch, and swordfish tested in Italy (Di Pinto et al. 2015), 50% of sole tested in Germany (Kappel and Schröder 2016), and 98% of bluefin tuna tested in Brussels (Oceana Europe 2015). Each of these studies found lower value fish mislabeled under the guise of higher value species. In California markets, a genetic study by Logan et al. (2008) reported that 60-63% of seafood sold as Pacific red snapper did not belong to any of the 13 rockfish species approved by the FDA to be sold under this name, but was instead identified to be true red snapper, tilapia, or other non-approved rockfish (*Sebastes*) species.

Mislabeling and fraud may even occur within certified fisheries, as demonstrated by Marko et al. (2011) for Chilean seabass certified by the Marine Stewardship Council (MSC). In response to the study by Marko et al., the MSC attempted to validate Chilean seabass labeling but lack of supply chain information rendered these efforts inconclusive (MSC 2011). MSC also conducts their own DNA testing, and in 2016 they found 99.6% of MSC labeled products were correctly labeled (MSC 2016a).

Illegal, Unreported, and Unregulated Fishing

High levels of illegal, unreported, and unregulated (IUU) fishing occur worldwide. Estimates of fishing losses to illegal activity range from \$10-23.5 billion, representing 11-26 million tons of seafood (Agnew et al. 2009). In the Pacific tuna fishery alone, recent estimates by MRAG Asia Pacific place the overall value lost to IUU fishing at approximately \$616.11 million U.S. dollars in ex-vessel value (2016). The study also found that misreporting and underreporting were the largest contributors to IUU, with illegal vessels taking only 4% of the catch (MRAG Asia Pacific 2016). This serves as an important reminder that we must not solely focus on the 'illegal' part of IUU but take into account the licensing, vessel monitoring and surveillance work that helps to address the other aspects of IUU fishing.

IUU products can find their way into local and international markets where they may unfairly compete with legal products. In the United States it has been estimated that as much as 20-32% by weight, or \$1.3 - 2.1 billion dollars of total value of wild caught seafood imports are from IUU sources (Pramod et al. 2014). Some countries suffer greatly from illegal catch within their borders, where illegal and undocumented fishing may nearly double the documented harvest numbers, such as in West Africa (Agnew et al. 2009; Pramod et al. 2014). An estimated 90% of the world's fish harvest is taken from Exclusive Economic Zones (EEZs) off coastal states; therefore, it is likely that a very significant proportion of IUU fishing



also occurs within EEZs. Developing countries lacking resources for effective fisheries management and enforcement bear the brunt of IUU fishing through lost revenue, decreased food security, and loss of biodiversity (FAO 2012b; FAO 2014a).

Recognizing that IUU fishing is a global challenge that no country can resolve in isolation, national government bodies and NGOs have increasingly turned to regulations and initiatives that increase information exchange and promote collaborative approaches to combating IUU fishing. The governments of the European Union and the United States have both developed traceability and catch documentation requirements for seafood imports in an effort to detect and deter IUU products (for more information about these traceability regulations see the Current Landscape section). Further, in order to help coordinate efforts and create a platform for information sharing about IUU fishing the NGOs [Environmental Justice Foundation](#), [Pew Charitable Trusts](#), [World Wide Fund for Nature](#), and [Oceana](#), have launched www.IUUwatch.eu. This website is a 'one-stop shop' for all information and news relating to the European Union's (EU) fight against IUU fishing - including documentation, facts and figures, opinion pieces, and blog posts. it

Human Rights

In addition to undermining fisheries management, illegal fishing can also be tied to human rights issues such as unsafe working conditions, little to no pay for fishermen, and trafficking of fishers and children, as highlighted in a UN Office on Drugs and Crime report on Transnational Organized Crime in the Fishing Industry (UN ODC 2011). Egregious human rights abuses like starvation, physical abuse, torture, and murder have been documented in seafood supply chains and widely exposed via media and industry reports (Kailola 2015; Urbina 2015). Labor abuses associated with Thai shrimp production were some of the first investigated and exposed (McDowell et al. 2015; Hodal et al. 2014), but other countries and products have also been named in reports (Mason et al. 2015; Stringer et al. 2016). Findings by the International Labour Organization (ILO), Environmental Justice Foundation (EJF), and the U.S. Department of Labor support the UN Office on Drugs and Crime's (UNODC) conclusion that human trafficking in the fishing industry is likely occurring 'in most major regions of the world' (UNODC 2011)

Labor abuse in seafood production has been attributed in many parts of the world to declining marine resources (Brashares et al. 2015). It is believed that in some cases reduced catch sizes have necessitated increased fishing effort as a means of offsetting the rising costs of fishing operations, and may have even incentivized IUU fishing and driven the demand for inexpensive labor. Migrant workers are common victims of labor trafficking via organized crime rings - coerced into slavery or indentured labor on fishing boats or processing facilities (Sylwester 2014). The fishing industry is vulnerable to organized crime in part because of the logistical difficulties inherent

“The findings by the International Labour Organization (ILO), Environmental Justice Foundation (EJF), and the U.S. Department of Labor support the UN Office on Drugs and Crime’s (UNODC) conclusion that human trafficking in the fishing industry is likely occurring ‘in most major regions of the world’ (UNODC 2011).”

in monitoring working conditions at sea and within an increasingly globalized seafood processing industry. On land, less visible links in seafood supply chains, such as local processing (e.g. shrimp peeling sheds), can be overlooked as a result of weak regulations and corruption within law enforcement. Further, a lack of transparency of vessel owners and vessel histories can also allow trafficking and forced labor to persist in seafood supply chains (Urbina 2015; Greenpeace 2014a,b). Comprehensive traceability mechanisms can allow companies to identify the countries of harvest and processing for seafood products, and therefore identify which are high risk for trafficking or forced labor (FishWise 2016a). For more information about social responsibility in the seafood sector see FishWise's white paper: [Social Responsibility in the Global Seafood Industry: Background and Resources](#).

Fishery and Aquaculture Improvement Projects

Seafood that is certified as sustainable or that tops the 'green lists' of many NGOs have been actively sourced and promoted at the point of sale for years by seafood companies. Now, Fishery Improvement Projects (FIPs) have been developed as a means of transitioning unsustainable fisheries into sustainable ones. Leveraging the power of the private sector through multi-stakeholder collaboration, FIPs seek to address environmental and management challenges via the implementation of time-bound improvement plans (see the Conservation Alliance for Seafood Solutions's [Guidelines for Fishery Improvement Projects](#)). Since FIP products have the potential to meet the responsible procurement policies of some companies (Conservation Alliance for Seafood Solutions 2016) there is now a need to incorporate traceability practices to ensure FIP products are correctly identified, and that the fishery can support its improvement claims. In response to this need, a growing number of fishery and aquaculture improvement projects are starting to investigate how best to incorporate traceability goals into their work plans.

Marketing and Promotion

Consumers may identify more with the human element of seafood than the sustainability of the products, so point of sale storytelling about a product's source or harvesters may have significant sales potential (Future of Fish 2016b). Selling fully traceable seafood would allow companies to tell better stories with greater accuracy, and substantiate sustainability claims with real data. Several programs, such as Gulf Wild® and ThisFish, are already promoting transparency as a selling point for their fish, and have built public-facing web portals that allow consumers to see where their seafood was harvested and even read the biography of the fisherman that harvested it.

Meeting Sustainability Commitments

In 2015, California Environmental Associates reported that over 90 percent of the top 25% North American retail companies by revenue had a sustainable seafood commitments of some kind - typically applying to their fresh and frozen products (CEA 2015). A robust traceability system is key in allowing companies to track progress towards their commitments and verify that goals have been met. In 2016 the Conservation Alliance for Seafood Solutions - an alliance of NGOs working to improve the sustainability of seafood in North America - updated some of the recommendations for seafood companies in their [Common Vision for Sustainable Seafood](#). The Common Vision outlines six steps seafood businesses can take to create and implement a sustainable seafood policy. The document gives advice, for example, on how seafood companies can set sustainability and traceability policies, collect data to track responsible sourcing. As the document states "understanding your products and where they come from enables you to assess the sustainability of your products, measure changes, and take action to improve supply

over time.” The Common Vision also lists key data elements (KDEs) that companies should track to identify product origins, measure progress towards commitments, and identifying areas of risk (such as illegal products or practices). Collecting and subsequently verifying these KDEs enables a more confident assessment of the sustainability, legality, and social responsibility of a product.

Current Landscape

Most of the seafood industry in North America uses the ‘one-up one-down’ traceability model, in which a supplier has records of receiving and selling fish along with documentation on all processing and handling that occurred while in their possession. These documents are typically in the form of purchase orders (POs), invoices, and bills of lading (BLs) with lot numbers referring to the raw material(s) and types of processing. If every step in the supply chain had accurate documentation and all product mixing was recorded, product would be traceable back to its source(s). However, in many supply chains, documentation is rarely requested to test if all steps in the chain have the proper protocols and procedures in place. The chain of custody (CoC) requirements of some certifications aim to do exactly that - verify via an on the ground site visit (audit) that proper product handling protocols and documentation systems are in place to allow for robust traceability.

However, we now have the technology and capability to share information in near real-time between all steps of supply chains, if data is stored electronically and the data systems are interoperable. Numerous other sectors are in the process of upgrading their traceability and data systems to this new best practice, and the seafood sector will derive great benefits if it follows suit. Points of mixing within the supply chain pose the most difficulty when trying to achieve interoperability, such as processing, auctions, and at sea transshipments (see Figure 1 - supply chain). Small fishing vessels in open access fisheries in which catches are unregulated, and therefore not documented at sea or upon landing, are an example of gaps in documentation that must be addressed. In some instances, documents are falsified to conceal illegally caught or mislabeled product, though traceability systems with automated spot checks would be able to detect these more often. With a greater focus on IUU fishing, seafood fraud, and seafood safety, the seafood industry must become more proactive in upgrading traceability practices to be able to meet their business needs and address shareholder concerns.

Challenges

There are many reasons that the seafood industry does not have 100% end-to-end, electronic, interoperable traceability. These include cultural, technological, and financial constraints such as:

- Seafood is a globally traded commodity, and language and technological barriers can hinder the use of standardized electronic systems for end-to-end traceability within supply chains. Also, scale greatly varies in supply chains - from a single vessel or farm to a processor or importer that handles millions of pounds of seafood per year. Because of these varying scales,



one solution may not work best for all companies within one supply chain.

- Technical systems (databases, barcode scanners, etc.) need to be functional and up to date to meet traceability needs. Limitations in resources, database expertise, and IT staff often allow for IT systems to become antiquated and not effective for comprehensive traceability. Companies are sometimes hesitant to invest in a traceability platform that will require ongoing investment and might not be interoperable with the systems employed by their suppliers or customers. For companies that sell more than seafood, the seafood portion of the business is often not the most profitable; therefore, other business areas may drive traceability or database decisions.
- Budgets often include the maintenance of an ERP (Enterprise Resource Planning) system to track sales and purchases but not additional traceability improvements.
- The seafood industry has traditionally operated based on relationships and trust, and supply chain information is often closely guarded. The idea that end-to-end, electronic, interoperable traceability allows for more transparency up and down the supply chain (to differing degrees) has some concerned about confidentiality and the use of information for competitor advantage, and the amount of information that is shared with seafood consumers. However, it is important to note that companies can implement *commercial transparency* so that non-proprietary information is shared while other proprietary information is not.
- Many companies are reluctant to invest in costly systems now, as governments may mandate new regulations that could render some systems inefficient or obsolete in the coming years. If a majority of the industry will adopt the same standardized system, it could pose a problem for the companies already invested in different traceability programs. This is less of an issue now that U.S. and EU have announced their IUU regulations, however there are still many regional programs being developed in seafood producing regions.
- Potential business advantages to be gained by investing in traceability have not been well articulated to harvesters and mid-supply chain companies in the past.
- Efforts in seafood traceability by governments, companies, and organizations are varied and are often not developed in coordination. However, this is also improving slowly over time with an increase in coordination and the creation of advisory groups for major initiatives.



United Nations Governance

The United Nations Convention on the Law of the Sea (UNCLOS) is an international agreement that defines the rights and responsibilities of nations in their use of the world's oceans and establishes guidelines for businesses, the environment, and the management of marine natural resources. The Convention is comprised of 320 articles and nine annexes, governing all aspects of ocean space, such as delimitation, marine scientific research, economic and commercial activities, transfer of technology, and the settlement of disputes relating to ocean matters. The Convention was enacted in 1994, a year after Guyana became the 60th state to sign the treaty. To date, 167 countries, and the European Union, have joined the Convention, though notably the U.S. has not signed the agreement. Today, it is the globally recognized Convention dealing with all matters relating to the law of the sea (United Nations 2013).

The United Nations Food and Agriculture Organization's (FAO) Agreement on Port State Measures to Prevent, Deter and Eliminate IUU Fishing (PSMA) entered into force on June 5, 2016. Countries that ratify the treaty must: 1) designate ports through which foreign fishing vessels may enter; 2) conduct dockside inspections following set standards; 3) block entry to vessels known or believed to have been involved in IUU or those on an IUU vessel list of a Regional Fishery Management Organization (RFMO); and 4) share information with the governments of vessels with IUU product, when discovered during inspection (FAO 2009). While the PSMA does not have traceability components, the requirements of captains to provide valid and legal fishing licenses, catch information, and vessel registration will have positive implications for traceability of product landed at participating ports. As of January 2017, 40 nations and the EU have ratified the treaty, and 14 countries have initiated the ratification process (Pew 2016). In order to stop IUU fishing and prevent IUU product from simply being redirected to other nations, it is necessary that all port countries ratify the PSMA. Additional nations have shown support for the PSMA by signing the treaty, indicating that the PSMA's reach will soon be expanding.

Unique Vessel Identifiers and Global Record of Fishing Vessels

Monitoring and enforcing the activities of vessels fishing in international waters is difficult, particularly due to the lack of mandatory unique vessel identifiers (UVIs). A UVI is an assigned number that stays with a vessel regardless of any change of ownership or flag state. The International Maritime Organization (IMO) number is the only UVI in operation on the scale needed for fishing vessels. IMO Resolution A.600 made IMO numbers mandatory for "propelled, sea-going vessels" over 100 gross tons, but excludes vessels "used exclusively for fishing" (EJF and FishWise 2013). In 2013 the IMO Assembly agreed to issue IMO numbers to large fishing vessels (over 100 gross tons), and they have issued them to over twenty thousand fishing vessels on a voluntary basis (Resolution A.1078 (28) (FAO 2013). The IMO has also granted IMO numbers to vessels smaller than 100 gross tons upon request, provided they have a steel hull and satisfy the other structural requirements.

From January 2016 to early 2017 five RFMOs began requiring fishing vessels operating under their authority to have UVI numbers issued on behalf of the IMO, and two more are expected to begin requiring UVIs in late 2017 (Long 2016). Without mandatory UVIs it is very difficult to identify or take action against IUU vessels because fishing vessel owners can implement complex vessel naming, registration and incorporation strategies to avoid detection (UNODC 2011). This includes sailing under various Flags of Convenience (FOCs). A FOC exists when a

vessel owner registers a vessel in a foreign state, often for the “convenience” of paying lower taxes and/or registration fees (ITF 2012). FOC states are attractive to IUU fishing operators because these states often lack the capacity or willingness to effectively monitor fishing activities (UNODC 2011). The transparency needed to identify and sanction vessels for IUU fishing and human rights abuses at sea will remain unattainable without UVIs for all fishing vessels, and IMO numbers for large vessels, especially those fishing under FOCs.

The [‘Global Record of Fishing Vessels, Refrigerated Transport Vessels and Supply Vessels’](#) is being developed to store the UVIs of commercial fishing vessels along with information on their ownership, flag, history, characteristics, and fishing authorizations. The Global Record is intended to be a tool for improving global transparency and traceability in the fisheries sector, and will work synergistically with the PSMA and the FAO’s Voluntary Guidelines for Flag State Performance (FAO 2016b). Entry of UVI information into the Global Record database will be voluntary. UN FAO member states through the Committee on Fisheries (COFI) have endorsed the Global Record as one of the main global tools to fight IUU fishing (FAO 2016b). Ensuring all large fishing vessels obtain UVIs that are entered into the Global Record will improve the ability to track and enforce fishing vessel activities.

IUU Blacklists

Currently, official IUU vessel lists are housed within Regional Fisheries Management Organizations (RFMOs), while some environmental NGOs and other government bodies also compile lists. Fishing vessels can be placed on RFMO IUU blacklists based on reports of suspected IUU fishing submitted by a RFMO member nation or cooperating nation. The commissions generally update their blacklists annually, after reviewing evidence of violations and rebuttals from the suspected vessel’s flag state.

Official and/or Compiled IUU Blacklists¹:

- [Combined](#) IUU Vessel List (vessels from all 8 RFMO databases)
- Conservation of Antarctic Marine Living Resources ([CCAMLR](#))
- Commission for the Conservation of Southern Bluefin Tuna ([CCSBT](#))
- Inter-American Tropical Tuna Commission ([IATTC](#))
- International Commission for the Conservation of Atlantic Tunas ([ICCAT](#))
- Indian Ocean Tuna Commission ([IOTC](#))
- Northwest Atlantic Fisheries Organization ([NAFO](#))
- Northeast Atlantic Fisheries Commission ([NEAFC](#))
- Directorate of Fisheries, [Norway](#)
- Western and Central Pacific Fisheries Commission ([WCPFC](#))
- Southeast Atlantic Fisheries Organization ([SEAFO](#))
- [EU](#) list of vessels engaged in IUU

United States Governance

Food Safety Regulation

The Food Safety and Modernization Act (FSMA) gave the United States Food and Drug Administration (FDA) greater authority to regulate food facilities, with the goal of shifting from

¹ [Greenpeace](#) also maintains an unofficial blacklist.

reactive to proactive approaches to prevent foodborne contamination (FDA 2011, 2016). FSMA empowers the Food and Drug Administration (FDA) to improve food tracking and tracing, based on lessons learned after conducting several studies and pilot projects. The FDA is directed to issue regulations requiring enhanced recordkeeping for what it determines and publicly identifies as “high risk foods”. The act also establishes an accreditation program for food safety auditors, but the list of ‘high risk foods’ had not yet been finalized. However, the FDA has released a proposed risk evaluation methodology for public comment (FDA 2017a).

The FDA also utilizes the Hazard Analysis and Critical Control Points (HACCP) management system to address food safety concerns in specific food commodities such as dairy, juice and seafood. HACCP plans are designed to aid in the prevention of contamination through the analysis of and control of biological, chemical and physical hazards throughout supply chains, and since their introduction there have been fewer instances of foodborne illness from seafood (FDA 2017b). Section 204 of the FSMA focuses on food traceability for improving responses to outbreaks of foodborne illnesses. Specifically, Section 204 requires the Secretary of Health & Human Services (HHS) to improve their ability to track and trace foods during foodborne illness events and to establish standards and timeframes for submitting information to the Secretary. Section 204 also calls for a publicly available list of high-risk foods and a pilot project to explore methods and technologies for tracking. However, though the pilot projects have been completed, the FDA has yet to release a list of high-risk foods (FDA 2011, 2017c). Other challenges also remain around achieving full implementation by the industry, progress assessment, and proper follow-up on non-compliances.

Resource Management, Traceability & Anti-IUU Fishing Policy

The Lacey Act was enacted in 1900 and is the oldest wildlife protection law in the United States (Lacey Act 2011). The original intent of the law was to preserve threatened native game species by prohibiting interstate shipment of illegally taken wildlife and the importation of invasive species. Today, the Lacey Act is far broader and makes it unlawful to “import, export, transport, sell, receive, acquire or purchase any fish or wildlife or plant taken, possessed, transported, or sold” in violation of any federal, state, foreign, or Native American tribal law, treaty, or regulation (16 U.S.C. § 3372(a)). The law also imposes marking, labeling, and documentation requirements (16 U.S.C. §§ 3372(b, d, f)). Protections for fish, which had previously been covered by a separate federal law (the Black Bass Act of 1926), were incorporated into the Lacey Act in 1981. The term “fish or wildlife” includes those bred, hatched, or born in captivity (16 U.S.C. § 3371(a)) so the Lacey Act also applies to aquaculture. There have been numerous cases that have used the Lacey Act to prosecute illegally imported fish (e.g. Tavernise 2004; ELAW 2016;

State Legislation - California

The California Transparency in Supply Chains Act went into effect on January 1, 2012. This act requires large retailers and manufacturers with sales of \$100 million or more in California to disclose what efforts they have taken to ensure their supply chains are not associated with slavery and human trafficking (S.B. 657 2010). Although the law’s main purpose is not traceability improvement, it does require disclosures concerning product supply chains, supplier audits and certifications, and internal accountability (K&L Gates 2012).

ALHC 2017).

The National Oceanic and Atmospheric Administration (NOAA) oversees fisheries management in the United States. The NOAA Seafood Inspection Program (SIP) provides inspection services for fish, shellfish, and fishery products to the industry and offers a variety of inspection services on a fee-for-service basis. Product quality evaluation, grading and certification services, laboratory analyses, training, consultation and export certification services are also offered by the NOAA SIP Program (NOAA SIP).

NOAA's Office of Law Enforcement (NOAA OLE) enforces regulations pertaining to the conservation and protection of the United States' living marine resources and natural habitats. NOAA's Office of Law Enforcement is responsible for carrying out more than 35 federal statutes, though most cases fall under five key legislative acts: Magnuson-Stevens Fishery Conservation and Management Act, Marine Mammal Protection Act of 1972, Endangered Species Act of 1973, Lacey Act Amendments of 1981, and the National Marine Sanctuaries Act. For law enforcement, the agency utilizes a combination of approaches such as traditional investigations and patrols, partnerships with state and federal agencies, technological tools such as Vessel Monitoring Systems, and outreach and education strategies designed to enhance voluntary compliance. The NOAA OLE is also responsible for enforcing U.S. treaties and international law governing the high seas and international trade (NOAA OLE).

Multinational Partnerships

The U.S. State Department, USAID, and The Association of Southeast Asian Nations (ASEAN) have a five year (2013-2018) [Ocean and Fisheries Partnership](#). One goal of this partnership is to design and implement a catch documentation and traceability (CDT) system in seafood supply chains that will align with the FAO's best practices, combat IUU fishing, and take an ecosystem approach to fisheries management. They are aiming to design "a transnational, standardized, electronic, interoperable, transparent CDT system for priority species."

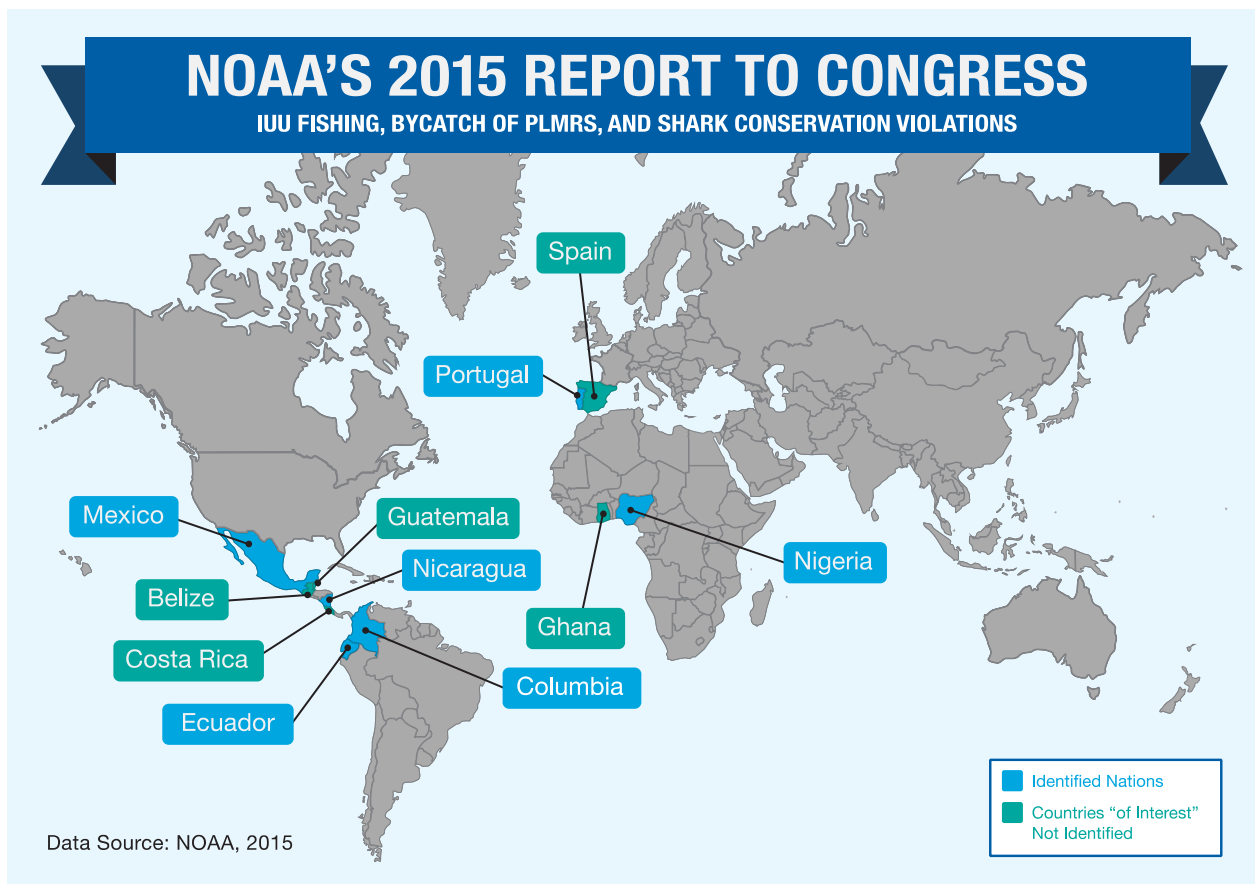
The NOAA Fisheries Office of International Affairs (NOAA FOIA) works with both domestic and international partners to promote stewardship of living marine resources and ecosystems. Through their partnerships NOAA promotes ecosystem-based fisheries management, combats IUU fishing, and ensures food security. NOAA accomplishes their mission by conducting workshops on living marine resource issues and by building partnerships to improve marine conservation. NOAA also actively participates in regional fisheries management organizations, multilateral and bilateral environmental agreements, and free trade negotiations (NOAA FOIA).

In order to comply with the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006, NOAA must release a biennial report to Congress outlining the agency's actions to improve international monitoring and enforcement of fisheries policy. NOAA must also provide to Congress a list of nations identified as engaging in IUU fishing practices, illegal bycatch, and other prohibited activities (Figure 2). NOAA is interested in IUU fishing because, "IUU fishing and seafood fraud undermine international efforts to sustainably manage and rebuild fisheries, and

creates unfair market competition for fishermen playing by the rules... (NOAA 2015).” NOAA Fisheries works with “identified” nations and those “of interest” to improve fisheries management and enforcement practices. Insufficient progress in these efforts by the next biennial report may lead to a fisheries product import ban to the U.S. and denial of port privileges to their fishing vessels. This system was intended to dissuade countries exporting seafood products to the U.S. from engaging in IUU fishing.

Figure 2: NOAA’s 2015 Report to Congress

In addition to reporting instances of IUU fishing, [NOAA’s biennial report to Congress](#) also describes occurrences of other prohibited activities including bycatch of protected living marine resources (PLMRs), violations of shark conservation measures, and others. Figure 2 includes *only* the countries mentioned with respect to illegal fishing in the report. While the countries in NOAA’s report are identified on the basis of their flagged vessels engaging in suspected or confirmed violations of U.S. fisheries policy and/or applicable international regulations, those vessels may or may not have also been in violation of the regulations of their flag nation.



Seafood Import Monitoring Program

In a landmark move for traceability policy in the United States, President Obama issued an Executive Order in 2014 calling for the creation of The Presidential Task Force for Combatting Illegal, Unreported, and Unregulated Fishing and Seafood Fraud (Task Force). Representatives from the U.S. Departments of State and Commerce co-chair a multi-agency committee tasked with designing an action plan for combatting IUU fishing and seafood fraud within the U.S. market. The Action Plan was released in March 2015, and contains recommendations ranging from expanding collaboration with other nations on the issue of IUU fishing, developing better technology for tracking imports, and ratifying the UN's Port State Measures Agreement. Recommendations 13 and 14 pertain to the development of a national seafood traceability program (known as the [Seafood Import Monitoring Program](#)) that will apply to seafood species entering U.S. commerce beginning January 1, 2018. Additional mandatory data pertaining to the harvest, landing, and chain of custody of products will be collected from importers via an electronic portal and verified via random audits. The proposed program will initially apply to a [short list of species](#) that the National Ocean Council Committee identified as 'at-risk' of IUU fishing and fraud, but could eventually be expanded to include all species. A voluntary 'trusted trader' program is also being developed which would run alongside the traceability program. [The Commerce Trusted Trader Program](#) seeks to reduce the compliance costs for eligible importers who purchase from trustworthy supply chains with robust traceability processes already in place. The process has involved many rounds of public comment, and many NGOs, industry members, scientists, and other international stakeholders have been involved.

European Union (EU) Governance

The EU has been a leader in setting strict regulations for seafood regarding food safety and anti-IUU measures. The European Commission's Directorate-General for Health and Consumers (SANCO) is responsible for food safety in the European Union. All countries that export seafood to the EU must be certified, which involves having (in part): 1) a competent authority responsible for official controls throughout the production chain, 2) a control plan for metals, contaminants, pesticides and veterinary drugs, if an aquaculture product, and 3) imports only from approved vessels and establishments that have been inspected by the exporting country's competent authority. The regulations also request a Health Certificate and information about the food safety practices of the importing nation.

In 2008, the EU established [Council Regulation No 1005/2008](#) to create a Community System to prevent, deter and eliminate IUU fishing. This traceability program seeks to ensure all seafood imported from outside the EU was caught and processed in compliance with a verifiable regulatory framework. As of 2010 each shipment of imported seafood products must be accompanied by a Catch Certificate validated by the vessel's flag state. The certificate requests information about the product's catch vessel, transport vessel, scientific name, and FAO catch area, among others (European Commission 2016). The certificate also states that the catch was harvested in accordance with the flag state's national laws and any applicable international conventions.

The European Commission's Directorate-General for Maritime Affairs and Fisheries (DG Mare) manages the [European Union Common Fisheries Policy](#) (CFP). Reforms to the policy introduced additional sustainability and traceability requirements aimed specifically at reducing IUU fishing.

To enforce CFP rules, a control system, established in 2009 ([1224/2009; Article 58](#)) and implemented in 2011 (404/2011), was designed to ensure that fish products can be traced back throughout the supply chain. Under the Health Certification regulations, the E.U. requires that countries wishing to import seafood are registered with E.U. authorities and can guarantee that the quality and processing of fish products are controlled at least to standards equivalent to those of the EU. At every point along the chain, for every consignment of fish, information must be provided that proves the legality of the catch. Fishing vessels, aquaculture facilities, cold storage, processors, etc. are identified with a unique ID code and must have one-up-one-down product traceability at minimum. Since enforcement and verification at sea can be costly, checks at every point in the chain are conducted at ports of landing or transshipment, during transport, and in processors and at markets. The control system applies to all fishing in EU waters, all fishing conducted by EU vessels in any waters, and recreational fishing on sensitive stocks and aquaculture regulated at the EU level (e.g. eel or bluefin tuna).

The legislation behind the Catch Documentation Scheme also empowers the EU Commission or their designated representative to conduct audits to verify the effective implementation of flag state data verification arrangements. The European Commission (EC) issues “yellow cards” and “red cards” to nations that have not taken sufficient action to control IUU activity in their waters or by their flagged vessels. Yellow cards serve as a formal warning to countries that the Commission wants to see time-bound improvement in their anti-IUU governance, while a red card can trigger economic sanctions and punitive trade measures. This carding system is in place to create disincentives for IUU fishing by countries who export seafood to the EU or who lend their flags to vessels that are in the EU supply chain, through threat of sanctions and ultimately potential exclusion from the EU market. This is one tool in place to help the EU reduce the risk of IUU product entering its seafood supply chains. [IUUwatch](#) keeps an up-to-date [map](#) of the countries that the EU has warned or sanctioned.

EU and U.S. Collaboration

In 2011, European Union commissioner for maritime affairs and fisheries, Maria Damanaki, and NOAA Administrator, Dr. Jane Lubchenco, signed a statement pledging to cooperate in combating IUU fishing (NOAA 2011). The EU and U.S. plan to work together to support the adoption of effective management measures, promote tools that prevent IUU operators from benefitting from their activity, and exchanging information on IUU operators. The agreement calls for exchanges of personnel, shared use of scientific infrastructure, support for joint research, access to laboratory facilities, scientific training and timely exchange of information (NOAA and European Commission 2012). As the EU and the U.S. are the first and third largest seafood importers in the world, respectively, this is an important step towards aligning global market expectations for legality. This agreement also helped set the stage for a similar agreement between the U.S. and Russia in 2015.

Other Nations

Australia

The Primary Production and Processing Standard (2006) has seafood-specific rules that aim to strengthen food safety and traceability standards throughout the supply chain. Under this mandatory standard, “seafood businesses must identify potential seafood safety hazards and implement controls that are consistent with the risk” (FSANZ 2017). They must also maintain one up, one down traceability records, ID species and record vessel names, capture date, and fishing area for wild catch (similar fields are required for farmed products).

Canada

Canada’s Catch Certification Program was created in response to the European Union’s Illegal, Unreported, and Unregulated fishing regulation implemented January 1, 2010. It requires that fish exports to the EU be accompanied by a catch certificate issued by the competent authority in the country of origin. The European Union also requires exporting countries to have an audit process in place to confirm the accuracy of the information provided in the certificate application. The Canadian Catch Certification Audit Office (CCAO) completes a target number of audits based on the percentage of certificates issued on an annual basis. The CCAO team applies a traceability process (consisting of a combination of data obtained from industry, Department of Fisheries and Oceans (DFO) databases and open source information) to verify that the fish exported can be traced back to the vessel or vessel group identified in the certificate application and to the time and area of capture. The audit also includes an assessment of exporters, buyers, processors and harvesters involving a review of the DFO violations and inspection databases and any other information that acts as an indicator of compliance (DFO 2012).

The Canadian Food Inspection Agency (CFIA) developed the Improved Food Inspection Model, a more prevention focused and systems-based approach to all Canadian food inspection systems (Scott-Thomas 2012; CFIA 2015). The CFIA verifies industry compliance through inspection, surveillance, sampling, and testing, and regulated parties must ensure that food commodities and processes they are responsible for comply with the law.

China

In 2015 an update to China’s 2009 food safety standards went into effect that includes some new traceability requirements (USDA 2015). It is similar in some ways to the United States’ Food Safety and Modernization Act (FSMA), in that it focuses on preventing and deterring food safety problems rather than prioritizing containment. Food traceability is mandatory as is GMO labeling, and the updated policy requires harsher penalties for food safety violations (USDA 2015). The Food Safety Law (2015) requires that all food companies establish a traceability system, and Article 42 states that “the State shall establish a full traceability system for food safety.” (USDA 2015).

Aside from food safety protocols, China does not currently audit traceability practices documenting seafood sources. Implementation problems with China’s documentation requirements pertaining to seafood product sources and provenance have been reported in the media, NGO white papers, and peer reviewed studies (Clarke 2009). Reports have said that China’s certificate of origin import declarations are often incomplete and poorly tracked, demonstrating there is still room for continued traceability improvement (D’Amico et al. 2014;

Mao 2014; Seafish 2015). Promisingly, regulators have stated their goal is to move China to full chain traceability for at-risk products.

Japan

Under the Quality Labeling Standard for Perishable Foods (2000) Japan has product labeling requirements that apply to some seafood product, but they do not have any government mandated traceability requirements for all fish products (Petersen and Green n.d.). Unprocessed products (including fish) must be labeled with the product name, country of origin, wild/farmed designation, and fresh/frozen. The labeling requirements for processed products - including fish products like fillets - differ depending on whether the product was produced in Japan or imported and are somewhat more detailed (FAO 2014b)

Traceability guidelines are being developed by industry associations. For example, the Food Marketing Research and Information Center created the Japanese Handbook for Introduction of Food Traceability Systems - a set of guidelines for the traceability of commodities such as fruits and vegetables, shellfish, eggs, and farmed fish. In this 2014 paper, it is unknown whether the Japanese food industry has adopted and implemented these guidelines (Charlebois et al. 2014).

On July 11, 2012, the EU and Japan signed a joint statement of agreement to work together to fight IUU fishing by not importing illegally caught seafood. The agreement commits the countries to “systematically exchange information on IUU activities”; promote management measures that strengthen control, monitoring, and enforcement; encourage other countries to ratify the Port State Measures Agreement of the UN FAO Committee on Fisheries; and promote the sustainable use of fisheries resources, while preserving marine biodiversity (European Commission 2014). Japan signed a similar joint statement against IUU fishing with the United States in 2015 (NOAA 2015). Japan and Russia also have an agreement to combat IUU fishing cooperatively, and as of December 2014 Japanese ports began only accepting Russian fish accompanied by authorization certificates issued by the Russian Federal Fisheries Agency (Undercurrent News 2014). Agreements promoting government-to-government information sharing are important signs of shifts towards traceability improvement in seafood.

Current Players

While this paper summarizes some of the challenges to implementing end-to-end, electronic, interoperable traceability and to ensuring seafood is legally and responsibly sourced, there is also a positive and uplifting side to this story. Increasingly, private sector companies are recognizing the importance of traceability and the benefit of communicating that work to stakeholders and consumers. NGOs, industry trade groups, and standards setting bodies are also supporting advancements in traceability as they work to create guidance documents and standards for seafood supply chains. Below we highlight some positive examples from various sectors.

Trade Groups Advancing Traceability

Examples of industry trade groups working to advance industry-wide traceability include the work of [National Fisheries Institute \(NFI\)](#). Several years ago NFI worked with [GS1 US](#) to create a [US Seafood Traceability Implementation Guide](#). Subsequently, in 2014 NFI's Traceability Working Group created a draft standardized list of data to be collected and shared within supply chains, or [key data elements \(KDEs\)](#) for identifying seafood sources. The KDE project was intended to define minimum requirements, make recommendations, and build industry consensus for traceability data collection.

Additionally, the [Food Marketing Institute's \(FMI\)](#) Sustainable Seafood Strategy Committee and its advisory councils, including non-profit organizations, have had several discussions surrounding traceability for wild and farmed seafood (Bartholomew 2012). FMI represents food retailers and wholesalers and develops and promotes policies, programs, and forums supporting its members, their customers and supplier partners, and other industry stakeholders in social, environmental, and sustainability programs. In 2012, FMI released a [Sustainable Seafood Toolkit](#), to assist food retailers with the implementation of seafood sustainability procurement policies by providing examples and identifying important considerations when developing policies. The importance of traceability is cited in almost all examples in the Toolkit, based on meetings and discussions with members of the Sustainable Seafood Strategy Committee, interviews with industry leaders, and a review of industry best practices.

Actions Taken by the Private Sector

Retailers have been recognizing the importance and many applications of seafood traceability and are now often naming it as an improvement goal within sustainable seafood commitments. For example, Albertsons Companies the second largest retail grocery chain in North America announced a range of sustainable seafood policies including a commitment to traceability that applies across seafood categories (including fresh/frozen products, sushi, and shelf-stable tuna) (FishWise 2016b). The Midwest chain [Hy-Vee](#) also made a public commitment in 2014 to improve its traceability practices by the end of 2015, and reached milestones in its data collection improvements, risk assessment of products, and communication of its traceability expectations with vendors. In 2016, Target joined the Seafood Task Force, which has established a core objective on traceability improvement (Seafood Task Force 2017). Other retailers incorporating traceability into their seafood procurement are Ahold Delhaize Group's (The Netherlands) U.S. [Hannaford](#) and [Food Lion](#) stores, who say in their 2015 sustainability report that their private-brand seafood products are traceable to the fishery or farm of origin (DelHaize Group 2015), and Wegmans (Rochester, N.Y.) markets, which have adopted interoperable traceability technology for their seafood (Wegmans Food Markets 2015).

Private seafood companies are also committing to improved traceability, such as [Thai Union Group](#) who have launched [SeaChange](#), a corporate strategy to reduce the risk of IUU product and illegal labor practices in its supply chains. As part of this initiative Thai Union have publically committed to achieving end-to-end traceability for all of its purchased seafood by 2020. Florida-based seafood company [Sea Delight](#) has made public commitments to sustainability, social responsibility, and traceability and have pledged to publicly report on their progress. Specifically, they plan to support traceability improvements within the FIPs, and to promote aligned approaches to interoperable traceability and standardized data collection (Sea Delight 2017). [High Liner Foods](#), a leading North American frozen seafood processor and distributor has also participated in numerous initiatives to improve seafood traceability - including participating (via Bill DiMento, their VP of Quality Assurance, Sustainability, and Government Affairs) in the Expert Panel on Legal and Traceable Wild Fish Products. The Panel was convened in 2013 by WWF “to promote a global framework for ensuring the legality and traceability of all wild-caught fish products” and in 2015 they produced a report outlining their vision for “boat-to-plate” traceability (EPLAT 2015).

Companies who primarily trade in a single seafood species are also making important strides towards improving the traceability of the products they sell. For instance, national brand tuna companies [Chicken of the Sea](#) and [Bumblebee](#) have each created traceability features that allow consumers to trace their canned tuna through individual codes printed on each can. This empowers consumers to look up information such as the species, catch location, catch method, vessel, and processing location of their product. [Tri Marine](#) has been able to support a range of initiatives that improve the traceability of tuna products - including transitioning skipjack and yellowfin tuna FIPs to MSC certified fisheries, adding a can code to [Ocean Naturals](#) product so consumers can learn where their tuna came from, and installing onboard electronic observers (MSC 2016b; Tri Marine 2017). Meanwhile, in late 2016 [F.C.F. Fishery Company Ltd. \(FCF\)](#) launched a [Sustainability Program](#) which establishes critical control points for tracking and tracing their FAD-free tuna from the harvest vessel, through transshipment, to port and processing. FCF has implemented observer requirements (human and electronic), tuna handling protocols (e.g. on-vessel product segregation of FAD and FAD-free), and traceability documentation requirements. Seafood processor and distributor [NorPac Fisheries Export](#), has under the leadership of founder Tom Kraft, developed and implemented a traceability software solution (Insight Solutions) to trace product from point of harvest to the retailer. In 2014 NorPac, Insight Solutions, and the Nature Conservancy launched an electronic traceability pilot program with one of Indonesia’s largest tuna processing plants that demonstrated the efficiency gains that business can gain from electronic traceability tools and hardware (Wietecha 2015).

This section presents just a few examples of trade group, retail, mid-supply chain, and producer efforts to improve traceability. There are many more private sector companies not mentioned here who are helping to make their supply chains traceable.

Non-profits

FishWise, Future of Fish, Institute of Food Technologists’ (IFT) Global Food Traceability Center (GFTC), and World Wildlife Fund are now working together as a Seafood Traceability Collaboration. The Collaboration seeks to catalyze transformative change in the seafood industry by working across the entire ecosystem of stakeholders necessary to build widespread adoption of traceability. This includes engaging companies from every sector of the seafood industry and supply chain, as well as the traceability technology vendors, government and

intergovernmental organizations, and NGO community. The goals of the Collaboration are to break down the barriers hampering broader adoption of effective and affordable interoperable seafood traceability, develop educational tools and learning experiences that incentivize industry action, and support companies in working individually and precompetitively to plan and deploy traceability systems.

In 2014 Future of Fish released [Getting There From Here](#), a report comparing seafood traceability technology providers. Their [Technology for Transparency](#) Pod is now working with members of the seafood industry and technology providers to understand where opportunities exist to improve data movement and retention in seafood supply chains, improve verification, and “keep [story](#) attached to fish.” Future of Fish, with input from the Seafood Traceability Collaboration, created a [Traceability 101 Toolkit](#) to provide NGOs working on traceability with information and resources.

IFT’s GFTC has experience working with science-based traceability across multiple food sectors. They have created numerous food traceability resources including a document outlining [‘Best Practices in Food Traceability’](#), a report on the [‘Impacts of Traceability on Business Performance’](#), and a [regulatory benchmarking study](#) of the traceability requirements of 21 OECD countries. IFT’s GFTC has also developed a range of seafood industry-specific tools, such as the [‘Seafood Consumer Preference Tool’](#) and the [‘Seafood traceability Financial Tool’](#). To advance seafood traceability on a global scale, IFT’s GFTC is also developing an interoperable seafood traceability technology architecture (see [issues brief](#) for more information). The architecture will be in input to the Global Dialogue on Seafood Traceability (GSDT), a cooperative effort between WWF and GFTC.

The GSDT is a precompetitive business forum for the seafood industry to develop a set of shared voluntary standards and business practices to make seafood traceability systems interoperable, affordable, and reliable. Complimentary to this effort WWF has developed [Traceability Principles for Wild-Caught Seafood Products](#) to align the NGO world around traceability. In 2015, WWF convened the Expert Panel on Legal and Traceable Wild Caught Products. The panel produced a [report](#) outlining traceability improvement recommendations for seafood businesses. Through work with on-the-ground fisheries and seafood industry partnerships WWF has created a global network of partners, giving them a unique on-the-ground perspective on traceability execution.

While this section highlights the work of the Seafood Traceability Collaboration, there are many other non-profits playing an important role in advancing the conversation and understanding of seafood traceability through the development of informational reports, guidelines, and collaborative efforts. For a more comprehensive list, see Appendices I and II.

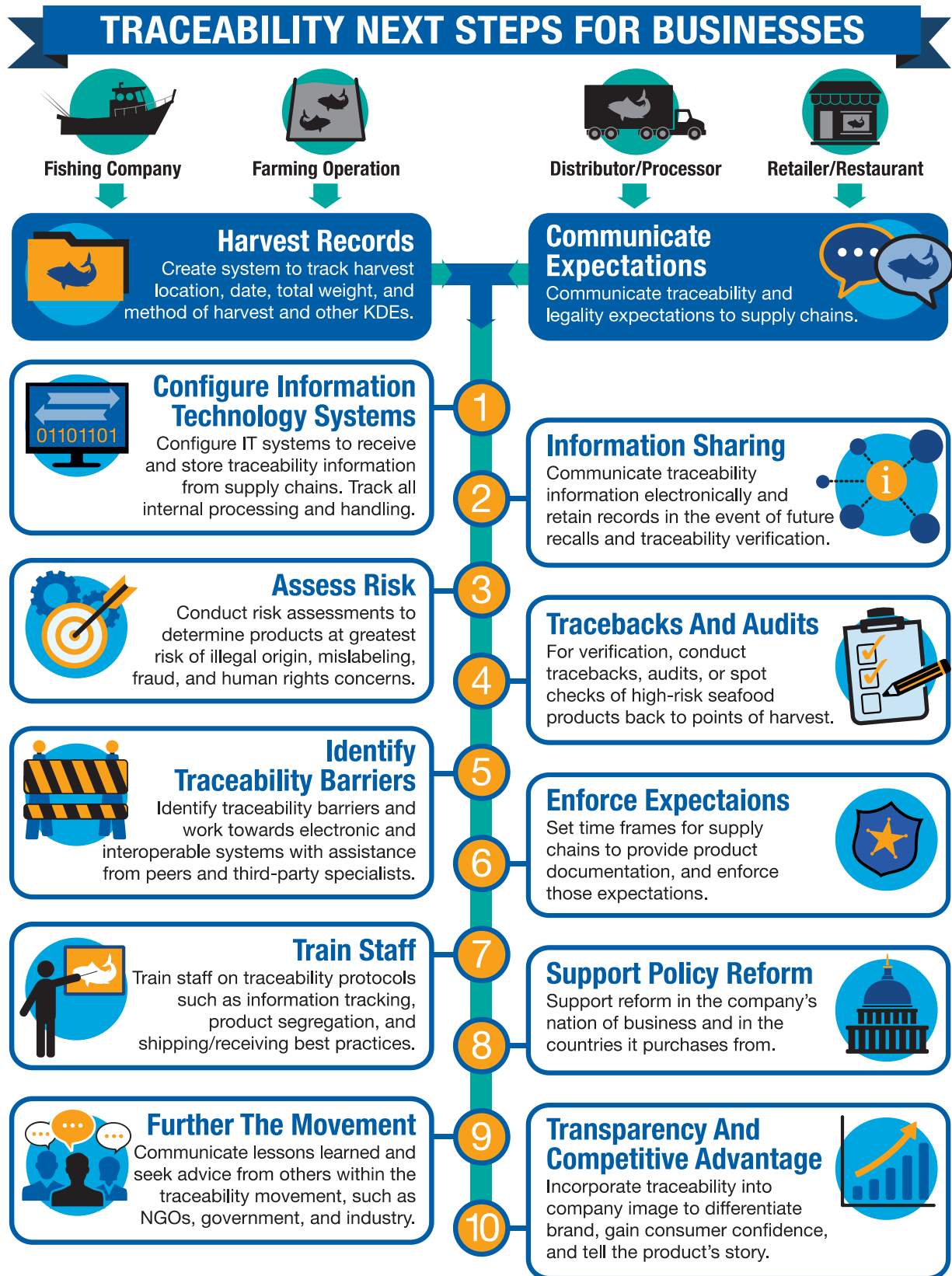
Cross-Sectoral and Precompetitive Initiatives

Industry players are coming together to collaborate on initiatives that take the cooperation and financial support of multiple leading companies. An example of such is [SeaPact](#), nine North American seafood companies working towards improvement of social, economic, and environmental responsibility throughout global seafood supply chains. SeaPact financially contributes to projects that fund its mission, such as one that is working to build a traceability system within a Brazilian lobster Fishery Improvement Project (FIP) (Sea Pact 2016).

The [Seafood Task Force](#) (formerly the Shrimp Sustainable Supply Chain Task Force) is a precompetitive, industry-led group, formed to tackle human rights and environmental issues in Thailand's seafood supply chains. The group consists of retailers, suppliers, NGOs, and major Thai processors and feed companies. Its work to date includes supply chain analysis, identifying the vessels harvesting the inputs for fish feed, the development of audit protocols, and support of the Thai government's development of port control measures and documents. One of its main objectives is to implement traceability systems with international verification from vessel to feed mill in Thai shrimp supply chains, and have this system become an independent, internationally recognized benchmark supply chain model within the industry.

In addition to key industry and NGO groups, a variety of other stakeholders contribute to driving improvements in the seafood industry. Certification programs can motivate investment in traceability and shift industry norms, and may also incentivize consumers to purchase more responsible and traceable products. Further, auditors and consultants investigate supply chains for strengths and areas for improvement, and foundations craft strategies to support efforts driving towards systemic change. For more information on some key players, refer to Appendix I. Organizations Working in Seafood Traceability

Figure 3: Recommended Next Steps for Seafood Businesses Seeking to Improve Traceability



Recommendations for Supply Chains

Figure 3 outlines some steps businesses can take to address traceability within their company and supply chains. These include:

Maintain Harvest Records

Producers of wild and farmed seafood products should maintain records of harvest sufficient to identify the harvest location, date, total weight, method of harvest, and other KDEs. Harvest records of some sort are required by most fisheries management bodies, and may be requested by customers in the supply chain. For instance, producers may receive requests for records from seafood import/export businesses subject to EU and U.S. traceability regulations.



Communicate Expectations



Traceability and legality expectations in a businesses' supply chain should be clearly defined and communicated to all suppliers. This can be done through the creation of a public Traceability Commitment, Supplier Code of Conduct, Supplier Expectations Letter, or detailed in a business contract. Staff should be made aware of these expectations and trained on traceability protocols and best practices.

The Conservation Alliance for Seafood Solutions' Common Vision Framework

1. Make a Public Commitment
2. Collect Data on Seafood Products
3. Make Responsible Sourcing Decisions
4. Be Transparent
5. Educate Staff, Customers, and Vendors
6. Support Improvements in Fisheries and Aquaculture

1. Configure Information Technology Systems

Information technology (IT) systems can be configured to collect, store, and share traceability data electronically in formats that are more easy to query, standardized to prevent error, and can be searched for anomalies in near real time. Key data elements (KDEs) should be tracked for all seafood products purchased and sold. All product handling, processing, or repackaging conducted should be recorded within a data system.



2. Improve Information Sharing



As a best practice, businesses should take steps towards adopting electronic and interoperable traceability systems that can be used to share KDEs quickly and in a standardized format. These design elements allow for more rapid and accurate information sharing between all companies within supply chains, thereby increasing transparency and allowing for full supply chain traceability. Businesses can start by having conversations about traceability data sharing with the companies in their supply chain.

3. Assess Risk

Some products have a higher risk of being harvested illegally, not traceable back to harvest, mislabeled, or associated with human rights concerns. Businesses themselves, or a contracted third-party, can conduct a risk assessment to identify high-risk products in supply chains and develop a plan to address these highest risks first.



4. Tracebacks and Audits



Once high risk products are known, tracebacks and audits of medium and high-risk items can be conducted. These exercises can help identify where known risks could be occurring in supply chains, if procedures are not comprehensive, or where risks are likely well-mitigated by robust practices in supply chains. To complement these in-depth reviews, spot checks of specific KDEs (e.g. fishing license or vessel name) can be a less-resource intensive, and therefore more frequently implemented, way to verify information.

5. Identify Traceability Barriers

Risk can occur where traceability barriers exist, so businesses should proactively look for these barriers within their internal systems and their supply chains. Barriers to traceability improvement can include: translation of information between languages or units in supply chains, lack of robust fishing vessel registration system, and unidentified steps in supply chains (e.g. peeling sheds). Once identified, companies can work with industry peers, NGO partners, or third-party traceability service providers to make improvements.



6. Enforce Expectations



A company's traceability and legality expectations of a supply chain should be enforced by requesting documentation to support traceability and legality product claims. If the documentation provided is insufficient businesses can work with suppliers to determine a timeframe by which systems should be improved and information must be shared. Actively engaging in improvements whenever possible, as opposed to discontinuing sources, will allow seafood products to become fully sustainable, traceable and legal over time.

7. Train Staff

Staff should be made aware of their company's traceability policies and supplier expectations. Members of staff responsible for handling or transporting product should be trained on traceability protocols and best practices. Companies passionate about particular topics can also hold trainings and webinars for their supply chains.



8. Support Policy Reform



Businesses should stay engaged with government initiatives and support policy reform in both its nation of business and in its supplying nations. One current example would be to

let governments in countries where a company does business know that it is important for seafood to be legally harvest, and ratifying the UN Port State Measures Agreement is an important step in that direction.

9. Further the Movement

Aside from government, businesses need to stay connected to other NGOs, fishery managers such as regional fishery management agencies (RFMOs), emerging technologies, and industry players in the traceability movement, sharing lessons learned and communicating the needs and objectives of all parties.



10. Transparency and Competitive Advantage



The environmental movement has found that inspiring stories can help encourage consumers to alter their purchasing habits to favor more responsible products. Traceability practices and policies can improve competitive advantage by differentiating brands, improving company image, and gaining consumer confidence. Communicating that competitive advantage will help both the greater movement and the company's sales and reputation in the industry.

Emerging Issues

As Figure 3 showed, there are numerous steps a company can take to improve the traceability of its products. Often, FishWise is asked what the 'hot topics' or 'emerging issues' are on the horizon for seafood traceability.

The ultimate goalpost that seafood companies should be working towards is end-to-end, electronic, and interoperable seafood traceability. To reach that point, there are several challenges that must be addressed in the short-term, including KDE alignment, verification, and improving information technology systems.

Aligning on Key Data Elements (KDEs)

Data collection, interoperability, and product assessment are hampered when requests for information are not aligned. Companies often receive requests for KDEs from a range of sources (e.g. their customers, the general public, their CSR department, and fisheries management or government agencies), and many ask for similar information (e.g. the location where fish was harvested). However, each source may ask for that information in different ways - with slight variation in the KDE meaning or format. Without semantic (meaning) and syntactic (format) interoperability, information cannot be shared efficiently.

Various efforts to standardize seafood KDEs are currently underway and the topic is a central conversation in key stakeholder initiatives, such as the U.S. Presidential Task Force on Combatting IUU Fishing and Seafood Fraud and the USAID Oceans and Fisheries Partnership Catch Documentation and Traceability System (CDTS) project. There are many publically available reports and guidelines that explain the importance of KDEs in the context of traceability, such as the [Common Vision for Sustainable Seafood](#), [Bhatt et al. 2016](#), [EPLAT report](#), and WWF's [Traceability Principles](#).

FishWise is collaborating with other NGOs to track all ongoing KDE conversations related to sustainability and publish a master list of compiled seafood KDEs from publicly available reports. These various workstreams and outputs will feed into the Global Dialogue on Seafood Traceability (GDST), a forum that aims to standardize KDEs to facilitate greater interoperability across the seafood sector. There will likely be a working group within the GDST that will be responsible for setting the business norms and practices associated with seafood KDEs. FishWise is tracking important KDE efforts and conversations to ensure that various projects and players are well connected and aware of each other's work. It is important to note that KDE lists should be updated periodically to reflect evolving seafood traceability best practices and industry standards.

There are several steps a company can take to ensure it is well-prepared to meet KDE requests from customers and regulators, as well as be able to handle the data being shared with them from trading partners. Companies can review the data they currently collect about products and assess how their data collection practices compare to their industry peers and KDE best practices outlined in the above-mentioned reports. Secondly, companies can assess their data collection systems and make the necessary improvements that will allow for their internal IT systems to receive, store, and exchange KDEs with other supply chain partners. It will be

important for companies to engage in opportunities such as the GDST where they can play a role in shaping KDE best practices.

Verifying Traceability

Companies usually share traceability expectations with their suppliers, sometimes adding the expectations to binding agreements like a Product Specification or Code of Conduct. However, fewer companies verify the traceability of their products. Groups seeking to advance traceability can advocate for the development and uptake of robust verification measures within supply chains. Verification mechanisms include DNA testing, traceability audits (documentation-based and in-person), and verifying certification claims. Innovative methods for improving the efficiency, cost-effectiveness, and robustness of verification procedures are needed.

Improving Information Technology Systems in Supply Chains

Many traceability experts recognize that a common technology architecture is needed to facilitate interoperable information sharing as has been accomplished in other industries like automotive, finance, and pharmaceuticals (Bhatt et al. 2016). The seafood traceability technology architecture blueprint that GFTC is developing will help enable global interoperable seafood traceability and provide the technological framework that the seafood industry currently lacks. The GSDT will be the vehicle for establishing the industry standards, standardized KDEs, and aligned business practices needed to enable interoperability. Companies can ensure they are on the path towards end-to-end, electronic, and interoperable traceability by upgrading their internal IT systems and engaging their supply chains in traceability improvements. The GDST provides an opportunity for companies to engage on these issues as well.

Conclusion

Ensuring that seafood supply chains are fully traceable and that product is legal and accurately labeled is a large undertaking, but it is a challenge that must be met head-on if companies are to achieve their sustainability goals. As government regulations and international media focus more on food safety, eliminating IUU fishing, and protecting human rights in seafood, it will be important that companies are also proactive on these topics. By better understanding and managing their supply chains, and developing the ability to track specific products back to their source, companies can mitigate or eliminate high-risk items while maximizing inventory control. Investing resources into solutions now will help to protect brand value, build consumer trust, and greatly reduce these environmental and social issues.

There are many resources, from traceability software solutions, auditors and consultants, to conservation NGOs that can provide assistance to businesses looking to improve their supply chain traceability. There are also steps companies can take now to begin to improve supply chain traceability, including clearly communicating expectations to their suppliers, improving internal tracking systems, conducting risk assessments and auditing high risk items. The contact list at the end of this report should prove a helpful starting point for those in the industry looking to identify groups and companies to work with on seafood traceability.

In the last decade, so much promising work has been done by so many to tackle seafood traceability issues. FishWise hopes that this updated white paper will spur further collective action between government, non-profit, industry, funders, and other stakeholders. If we work together to align traceability asks, improve verification, and adopt interoperable information technology systems we can all reap the benefits improved access to information will bring.



Acknowledgements

FishWise would like to thank the many peers, mentors, experts and industry stakeholders that provided feedback and reviewed parts of this paper. The collaborative approach of this movement is encouraging, and gives hope that this difficult challenge can be addressed, and the associated environmental and social problems eliminated.

To be updated on future traceability work by FishWise, subscribe to FishWise's Traceability Mailing List at <http://www.fishwise.org/contact-us>.

RESOURCES



Appendices of Supplementary Resources and Guidance

Appendix I. Organizations Working in Seafood Traceability.....	35
Appendix II. Resources on Traceability.....	55
Appendix III. Contacts.....	59
Appendix IV. Works Cited.....	68

Appendix I. Organizations Working in Seafood Traceability

Here we present a suite of groups that may be helpful as companies seek to implement traceability improvements within their supply chains. These organizations are actively working on traceability within the seafood industry. This is not intended to be an exhaustive list or serve as an endorsement from FishWise. Rather, we have focused on groups at the intersection of traceability and seafood with operations or projects within North America. These summaries were either provided by the groups themselves or gathered from publically available information on their websites. We have not attempted to independently verify their claims.

Specific contact information for each group listed is included in Resources Section, Appendix III. Contacts.

Environmental and Traceability Certifications

Certification programs set requirements that an operation must meet in order to receive certification. For the most part, certification standards in the seafood industry have been focused on improving ecological sustainability and traceability, but some are also beginning to address social criteria. The organizations listed below are certification programs that include traceability requirements for the seafood industry and are typically seen in the North American market. The summaries were either provided by the groups themselves or gathered from publically available information on their websites. We have not attempted to independently verify their claims.

Alaska Responsible Fisheries Management Program

[The Alaska Responsible Fisheries Management \(RFM\) Program](#) is a rigorous, ISO accredited third-party certification program for wild-capture fisheries. RFM ensures that Alaska Seafood is globally recognized as sustainable and responsibly sourced. The Alaska RFM Chain of Custody Standard ensures that seafood products bearing the RFM Certified Seal or a certification claim can be directly traced back through the supply chain to the certified fishery. RFM gives Alaska's fishing industry a choice in demonstrating to the domestic and global marketplace the sustainability of fisheries. The Alaska RFM Fisheries Standard is directly based on the world's most comprehensive and respected fisheries management guidelines developed by the United Nations Food and Agriculture Organization, developed through collaboration amongst governments, scientists, and conservationists.

Aquaculture Stewardship Council

[The Aquaculture Stewardship Council](#) (ASC) operates with Chain of Custody (CoC) certification to ensure traceability. The ASC has set up the CoC requirements and procedures with the Marine Stewardship Council (see more details under the MSC section of this report). The ASC has been using the MSC Chain of Custody (CoC) approach for all its standards. In order to monitor and evaluate the effectiveness, the ASC additionally carries out tracebacks (manual exercises to identify the actual sources of products) on occasion. The CoC certification for the ASC was launched in January 2012.

Fair Trade Certified Seafood

In 2014, [Fair Trade USA](#) launched its [Seafood Program](#) in an effort to bring the benefits of Fair Trade to small-scale fishermen and their communities. Through Fair Trade certification and improved market access, strong fishing communities are built by ensuring financially stable fishing families, safe working conditions, access to services through community development premium investments, and biologically healthy marine ecosystems. The Fair Trade certification and audit process uses a stepwise approach that requires improvement of social, economic, and environmental conditions over time. To ensure that Fair Trade seafood can be identified and traced along the supply chain, all traders must adhere to Fair Trade traceability guidelines as well as provide and retain Chain of Custody records with Fair Trade-required product information.

Food Alliance

The [Food Alliance](#) launched its sustainability standard for farmed shellfish in 2010 and began certifying to that standard in 2011. The standard applies to North American shellfish farms that produce oysters, clams, mussels, and geoducks. The program does not cover wild harvest. As with all Food Alliance Certified agricultural products, any shellfish product that carries the Food Alliance Certified seal must be certified from production through packaging. Handling facilities that pack or process Food Alliance Certified shellfish products undergo annual third-party inspections that verify certification documentation for incoming products and ensure traceability, product integrity, and proper labeling through receiving, processing, storage, and shipping procedures. Retailers are only allowed to market unpackaged shellfish products (e.g., bulk mussels in the seafood case) as Food Alliance Certified if the package from which they came carried the certification.

Friend of the Sea

[Friend of the Sea](#) (FOS) - non-profit organization - is committed to improving the global sustainability of seafood by developing international certification programs for sustainable fisheries and aquaculture. FOS criteria follow the FAO Guidelines for ecolabeling and include traceability. FOS chain of custody standard is designed to ensure certified seafood can be traced back to the sustainable source. The requirements state that a program must be in place to prevent product mixing with uncertified sources, that origin and fishing method are identified, and that the fishery uses all available interconnected traceability methods for larger boats as part of a marking system and non-forgable document tracing system. Furthermore, one test at the beginning and end of a batch of finished product must be conducted, inspecting relevant documents for conformity to the standard. Audits are run onsite by independent certification bodies.

Global Aquaculture Alliance

The [Global Aquaculture Alliance](#) (GAA) Best Aquaculture Practices (BAP) standards require verifiable systems for traceability that fully account for all inputs, production, and outputs at each step in the production chain. Systems can be online, paper, electronic, or a combination and are verified during on site audits. Mass balance and mock recall tests are required both by the facility and during the audit. Audits are conducted annually by Independent ISO 17065 Accredited Certification Bodies. Each audit includes full traceability systems tests and traceback exercises. Traceability verification tests are also conducted in the marketplace through identifying product in stores and performing tracebacks on a routine basis. Rules regarding

proper traceability and use of the BAP Certification Mark are also established as part of the BAP Certification Mark Agreement.

GlobalG.A.P.

The [GLOBALG.A.P.](#) Aquaculture Standard operates under a third-party accredited certification system. To claim certified status at point of sale, all stages of production must be certified: feed, seedlings, farming, and post-harvest activities. Certification is linked to the scientific name of the product. It's currently the only standard at farm level recognized by the GFSI. GLOBALG.A.P. Aquaculture Certification requires the Integrated Farm Assurance All Farm & Aquaculture Modules, the Chain of Custody Standard, and the Compound Feed Manufacturing Standard. The new voluntary Responsible Operations Standard Add-on for feed mills supplying to GLOBALG.A.P. certified farms adds social, environmental, and marine sourcing sustainable criteria to the compulsory food safety requirements and good manufacturer practices. There are currently 30 species certified under this system in 35 countries worldwide. Recall/withdrawal mock tests are mandatory and must be performed annually.

International Organization for Standardization

The [International Organization for Standardization](#) (ISO) is an independent, non-governmental international organization with a membership of 163 national standards bodies. Through its [members](#), it brings together experts to share knowledge and develop voluntary, consensus-based, market relevant International Standards that support innovation and provide solutions to global challenges. ISO has developed standards for: traceability of finfish products - specifications to be recorded in captured distribution chains ([ISO 12875](#)) and farmed distribution chains ([ISO 12877](#)); traceability of crustacean products - specifications on the information to be recorded in captured crustacean distribution chains ([ISO 18537](#)) and farmed crustacean distribution chains ([ISO 16741](#)); and traceability of molluscan products - specifications on the information to be recorded in captured molluscan distribution chains ([ISO 18539](#)) and farmed molluscan distribution chains ([ISO 18538](#)).

Marine Stewardship Council

The popularity of the [Marine Stewardship Council](#) (MSC) certification continues to increase, and with it the Chain of Custody (CoC) traceability that accompanies certified product. Companies that want to use the MSC ecolabel must obtain independent verification that the product originated from a certified fishery, which must be demonstrated by a CoC certificate held at each link in the chain. To use the MSC ecolabel companies must also have an MSC ecolabel license. The MSC CoC is an example of combining 'one-up one-down' traceability paper documentation and on the ground audits of traceability procedures and protocols.

Certification Accreditation Bodies and Auditors

Certification accreditation bodies are third-party organizations that provide certification, testing, and inspection services against internationally recognized standards. Auditors ensure certification standards are being met through on the ground verification. These summaries were either provided by the groups themselves or gathered from publically available information on their websites. We have not attempted to independently verify their claims.

MRAG

The three [MRAG](#) companies (MRAG Americas, MRAG Ltd., and MRAG Asia Pacific) provide traceability services to help companies ensure that seafood was caught legally and sustainably. MRAG has worked globally on these issues and has offices in Europe, North America, and Australia. Its services include: customized, confidential, and independent traceability audits of products from catch to consumer; confidential risk assessment to combat IUU fishing and ensure seafood has not been caught illegally; audits for the International Seafood Sustainability Foundation (ISSF) ProActive Vessel Register (PVR); MSC chain of custody and fishery assessments and certifications; and confidential third-party supply chain audits.

SAI Global

[SAI Global](#) is an international risk and compliance company working across agri, aqua and other non food sectors. They support businesses in standards, compliance assessment, risk review, learning, improvement, and certification services. In the seafood sector, SAI Global can provide supply chain risk assessment, traceability reviews, risk assessment in IUU, social accountability, and environmental performance. SAI Global is accredited to many international standards in seafood such as MSC, Alaska RFM, ASC, GAA BAP, and Global GAP. They can offer off-shelf audit solutions or customized services to meet client needs.

Scientific Certification Systems

[SCS Global Services](#) (SCS) is a third-party environmental and sustainability certification, auditing, testing, and standards development service. For over 30 years, SCS has recognized achievements in sustainable seafood, food and agriculture, forestry, product manufacturing, and more. SCS' seafood experts work with supply chains, fishing associations, aquaculture producers, governments, non-governmental organizations, and investment funds to move the industry towards certified best practices. Their independent verification of supply chain traceability, wild-capture fisheries, and aquaculture operations help ensure that client claims are credible, transparent, and promote increased market access. SCS issued the first MSC Fishery and Chain of Custody certificates in 2000, and is a founding contributor of the ASC. SCS' sustainable seafood staff have also participated in the label's Technical Advisory Group.

DNA Testing Companies

DNA testing companies can be used to verify product quality, safety, and/or species identity. These summaries were either provided by the groups themselves or gathered from publically available information on their websites. We have not attempted to independently verify their claims.

ACGT, Inc.

The goal of seafood traceability programs is to provide definitive evidence of the path seafood takes from water to fork. While it's possible to develop DNA fingerprints for individual fish or shellfish as they enter supply chains then confirm each through testing at the end of their journeys, the expense and time consumed is too great for most applications. Exceptions would be high value commodities such as bluefin tuna. Identification of species is far less complex than identification of individuals, and Seafood ID from [ACGT, Inc.](#) routinely utilizes DNA analysis to identify seafood species. In a traceability program, a species snapshot of representative or "sentinel" fish or shellfish - not individuals - provides a valuable and economical spot verification

of pre-existing validated processes. ACGT, Inc. welcomes the opportunity to work with seafood certification organizations and companies that perform supply chain oversight.

Applied Food Technologies

Sustainability requires knowing not only where a fish was caught, but what fish was caught. [Applied Food Technologies](#) (AFT) offers a DNA-based species identification service for seafood which meets FDA's guidance by relying on adequately authenticated samples rather than publicly available databases. Unlike other service providers, AFT compares all fish to a database generated from taxonomically identified references. Because the FDA's current guidance states that they will only make regulatory decisions based on identifications using adequately authenticated standards, AFT helps a firm comply with the FDA's guidance. AFT has been performing species identification work for the better part of a decade and clients for seafood species testing have included the FDA, NOAA, state governments, distributors, retailers, grocery store chains, and restaurants, among others.

BonifIDcatch

[BonifIDcatch](#)[®] is an independent consumer advocacy company whose mission is to educate and guide consumers to reputable seafood retailers by ensuring seafood is accurately labeled. Verification is accomplished through DNA barcoding that identifies species, farmed vs. wild, genetic modification (GM) and proper use of FDA market names. BonifIDcatch[®] certifies restaurants and retailers who serve correctly labeled seafood. They use a chain of custody process to sample products and a proprietary database to analyze DNA barcodes. Sampling is done by actors posing as customers during unannounced store/restaurant visits. BonifIDcatch[®] earns its revenue from the retailers in exchange for their independent certification service and promotion of properly labeled product.

InstantLabs

Mislabeling of seafood in seafood supply chains is a global issue. This form of seafood fraud costs governments, companies, and consumers billions of dollars annually. It also puts brand reputations and human health at risk. [InstantLabs](#) has partnered with the FDA and the University of Guelph to develop a breakthrough technology that allows for rapid and easy on-site DNA-based identification of seafood samples. Now anybody in the supply chain can know in less than two hours if the piece of seafood they are holding is actually what it is supposed to be. [InstantID](#)[™] test kits are currently available for Blue Crab, U.S. Catfish, Asian Catfish, Atlantic Salmon, Coho Salmon, Chinook Salmon, and Sockeye Salmon with new kits being added regularly.

Therion International, LLC

For over 20 years, [Therion](#) has been the leader in providing quality DNA testing of seafood products to verify species and stock identification for species of grouper, halibut, salmon, sea bass, snapper, tuna, walleye, crabs, shrimp, etc. Present and past clients have included the U.S. Fish and Wildlife Service, NOAA, Greenpeace, Oceana, Bonefish Grill, Darden Restaurants and scores of importers, distributors, and purveyors of seafood. It is the opinion of Therion that DNA testing for both species and stock identification could be the ultimate tool for the verification of traceability systems, thereby enhancing sustainability, enabling fraud detection, and ultimately providing better consumer protection. Therion stands ready to provide DNA testing or develop novel assays to address questions of seafood species or stock identification.

TRUfish

[TRUfish](#) uses DNA testing technology and sampling protocols, informed by real-time risk evaluation, to provide a seafood fraud detection and prevention system. Customers include seafood vendors throughout the global supply chain: producers, processors, distributors, restaurant chains, and retailers. This service can also be utilized by government agencies as a seafood inspection, enforcement, and trade expansion tool. TRUfish's proprietary system assembles data from customer and public databases to determine risk and performs third-party, statistically validated testing at multiple levels of the supply chain. TRUfish is most effective in preventing fraud when used in tandem with other traceability mechanisms as an essential verification tool.

Traceability Programs and Technology Solutions

Traceability programs and technology solutions companies provide electronic platforms for seafood data capture, sharing, verification, and tracking. These summaries were either provided by the groups themselves or gathered from publically available information on their websites. We have not attempted to independently verify their claims.

BackTracker

[BackTracker](#) is an electronic seafood traceability and verification platform that authenticates supply chain information against official landings data collected by government. BackTracker provides a third-party verification of seafood purchased against the original fishing vessels lot or landing. As product moves through the supply chain participants using BackTracker can verify key product attributes such as species, fishing vessel, fishing area, landing port and volumes against official government landing records. All of the data in BackTracker is encrypted so users can determine which information is shared and what data is kept confidential, and all the supply chain and government reporting information remains locked down in a confidential data bank. Full authorization is retained with the Data Owner who determine the level of data sharing protocols based on their own data aggregation and verification rules.

Dynamic Systems, Inc.

[Dynamic Systems, Inc.](#) is a barcode tracking solution to be used at the dockside, on the production line, and in storage and shipping. Dynamic Systems, Inc. uses their SIMBA seafood labeling and traceability software to collect, consolidate, and report real-time information, print barcode labels, maintain lot traceability, and calculate yields. The components of SIMBA systems are as follows: automated data collection points that report product details and movements; SIMBA Office, where all data is consolidated and reported; SIMBA Production, a touch-computer connected to the Office system or on a mobile tablet; and SIMBA Logistics, which records inventory moves and detailed shipping information. With SIMBA, Dynamic Systems proves its partners with the required hardware (touchscreen, mobile scanner, and barcode printer) that are designed for the harsh environments of seafood plants as well as labels designed for wet, cold environments.

FishTrax

The [Fish Trax™](#) system is an electronic platform for collecting, analyzing, and sharing fisheries information. Envisioned initially by fishermen and scientists to track important resource data, Fish Trax™ has now expanded to serve as a tool for the seafood industry, allowing managers,

scientists, regulators, and marketers to collect data and collaborate on ways to improve sustainable resource management, marketing, traceability, and business practices. At the heart of the Fish Trax™ system is a secure and robust database, with specially designed and easy-to-use “portals”, that allow clients to securely input and export data and information to meet the needs of a variety of audiences. The portals are designed with unique features to help translate raw data into valuable knowledge that help users maximize their real-time business, management, and marketing decisions.

Frequentz

[Frequentz](#) is a supporter of end-to-end visibility, offering comprehensive traceability, serialization, and information management technologies. Frequentz's technology captures a number of data points and attributes for a given item, including catch location, method, and species information and transfers them along the chain of custody to processors, retailers, and restaurants. They partner with certified testing labs to provide DNA results to its partners about their products. Frequentz offers insight into end-to-end supply chains, and critical business processes by collecting, storing and analyzing serialized, life history data via IRIS (Information, Repository & Intelligence Server). Applications of its software, including mobile data capture, are currently used in the fishery, life sciences, agricultural, sustainability, and retail sectors worldwide and promote intelligent analytics and consumer safety. Frequentz is a certified member of the GS1 US and GS1 Global Solutions committees.

fTrace

[fTRACE](#) software solution can trace the history of a product down to the individual batch - over the entire manufacturing and processing chain. Manufacturers and suppliers can capture and share batch-specific data (e.g. on catch area, catching gear, farming or fishing practices, as well as the unloading port or vessel owner). fTRACE combines this data with dynamic data relating to the catching or production date, time, and place. Due to customer trust becoming an increasingly important competitive advantage, fTRACE enables companies to deliver the requested product information, as well as additional information about fish species or recipes. To do this, consumers can download the fTRACE app on Apple and Android. fTRACE is a platform operated by GS1 Germany, responsible for the GS1 article identification system GTIN for globally unique identification and other technologies for transparent and efficient value chains.

INSCATECH

[INSCATECH](#) is a food fraud detection and prevention firm. To address the pervasive problem of seafood fraud (including substitution, concealment, IUU fishing, and slave ships) INSCATECH's operatives use a combination of intelligence gathering techniques, including satellite imagery, to combat seafood fraud throughout the entire supply chain. INSCATECH's services include food fraud intelligence investigations, forensically based vulnerability assessments, supplier qualification examinations, validated supply chain mapping (traceability), and food fraud control programs. INSCATECH has recently introduced its GenuFish certification program which combines INSCATECH's investigative capabilities with scientific testing technologies and methodologies. GenuFish is a B-to-B certification program that is designed to root out fraud and corruption in the seafood industry. The GenuFish certification represents to buyers and purveyors of seafood that the origins and species of seafood are ethical and authentic.

Insite Solutions

[Insite Solution](#)'s programming provides end-to-end supply chain traceability within a web based, scalable solution. Utilizing GS1 barcode standards, the system is compatible with legacy ERP systems, express delivery service company software and consumer facing information systems. The modular structure allows for flexibility and economical application within diverse operating environments. Developed within the seafood industry, Insite Solutions delivers a robust, user-friendly platform, designed for the dynamic and harsh environment of the seafood industry. Material receiving, inventory, processing, value adding, labeling, packaging, shipping and reporting are supported. Insite Solution's database seamlessly shares information across platforms, supporting fishery management and business management data needs, as well as upstream customer information requirements. Fully auditable, multi-level, password protected access provides assurance of the integrity and security of the data.

Intact Systems

[Intact Systems](#) provides software solutions for supply chain integrity management - including traceability, auditing, and certification management. Intact System's Ecert supply chain monitor can monitor certification statuses of suppliers automatically and calculates mass balances of incoming and outgoing goods. The open web service API allows importing data in real time directly from any third-party system - e.g. from certification bodies, standard setters, processor's ERP systems or other batch traceability systems. In addition, it offers a visual overview of supply chains with the supply chain graph. The traffic light system shows where the integrity of a supply chain is at risk. The system sends automatic notifications if certification statuses change or mass balances are beyond common standard.

IQMI

[IQMI](#) provides technology solutions that enable fishermen to accurately capture the data from their work at sea, allowing for both regulatory compliance and empowering them with their own data in industry discussions. IQMI's mobile data collection program allows partners to record, transmit, save, and share production data generated at the location and time of harvest. IQMI's AuthentiQ traceability platform collects data to 'attach' to the product in such a way that the consumer can access them at the point of purchase or consumption. This allows consumers to validate a product's origins, in real-time, using data collected at the point of production.

mFish

[mFish](#) is an initiative that was designed to cross the digital divide for rural Indonesian fishermen. It is a joint effort pilot from Tone and the U.S. State Department to build sustainable solutions through mobile technology for fishermen in rural areas. The first mFish pilot provided kits containing a smart phone, 1 GB of free data and solar charger to fishermen in Lombok. The phones provided connectivity while they were at sea, GPS and maps of their location day and night, weather information, catch logging data and rich messaging capabilities. The goal of this program is to provide equal access information to Indonesian fishermen, and to give them a real meaningful connection to local NGO's to report their catches. mFish Indonesia is currently active in Sumenep, Pamekasan, Bali, Cirebon, Labuhan, Ampenan and Bangkalan.

Pelagic Data Systems

[Pelagic Data Systems \(PDS\)](#) provides vessel and fleet tracking solutions designed specifically for artisanal fisheries. The hardware is tiny, durable, solar-powered, and completely autonomous. Data is transferred automatically to secure servers. High-resolution data enables automatic

identification of when/where fishing occurs, type of gear used, and can monitor storage temperatures. The system maps and measures fishing effort to assist managers, support rights-based management systems, and provide monitoring for illegal fishing activities including in protected areas or using illegal gear. The PDS solution not only integrates into any traceability system so that fisheries/distributors/processors can simply expand their existing supply chain platform to achieve complete "boat to plate" transparency and traceability without changing their workflow, it also helps improve product quality by verifying cold chain. PDS is actively working with industry, governments, academia, NGOs, and communities worldwide.

Point 97

[Point 97](#) provides global solutions and technology that facilitates the collection of trusted and more reliable data for fisheries management, seafood trade accountability, profitability, and traceability at sea, at the docks, and in the markets. Point 97 features three products; DECK, DOCK, and MARKET. When used on their own or integrated together as a complete system, their products serve as a back-end data collection component that is interoperable with consumer facing traceability platforms. Looking into the future, rather than relying on people to generate data, Point 97 is actively developing their data capture and management tools of tomorrow with computer vision, sensor, and laser technology to improve accuracy, efficiency, and cost of fisheries data collection and monitoring.

Scoring Ag

[ScoringAg](#) is an interoperable database with *Site-Specific Recordkeeping™* and standardized records that includes seafood, feed ingredients, SSOP and HACCP, as well as certification on containers and harvest records in one worldwide working system. ScoringAg's database can integrate information from any other database including using the QR /GS1 codes. ScoringAg records start at the fishing site or farm and go all the way through the entire supply chain, up to the retailer and consumer with an automatically created traceback code label as a unique identifier for FSMA. These unique SSI-EID traceback codes stay with the seafood from harvest throughout any processing and commingling process without losing its identity. The system can handle paper and PDA electronic record keeping with DNA records, and can generate GPS labels for fishing/shipping or receiving in real time. ScoringAg can be applied to all perishables.

Seasoft Software

[Seasoft ERP Software](#) includes a direct interface to Trace Register, a web-based tool to share product information throughout supply chains. The software stores information about a specific product's origin and MOP so businesses can confidently promote their products as coming from sustainable fisheries utilizing environmentally sensitive harvesting practices. Seasoft is barcode-ready, helping distributors track product as it's received, processed, and moved throughout supply chains. Barcodes can be assigned to containers of finished goods as well as containers used in making a batch of food, then scanned anywhere in the supply chain to trace the raw material to the batch. By barcoding COOL, MOP and other information, seafood distributors have an efficient and accurate mechanism for quick and thorough product recalls and Department of Health inspections.

Shellcatch

The [Shellcatch](#) solution includes traceability technology, a customizable, software-as-a-service package with bycatch and coastal video analytics, and comprehensive training and capacity building for artisanal fisheries. Shellcatch current international relationships range from

government programs, national and international conservation initiatives, specialized NGOs, BSR corporations, small and medium size distributors, restaurants, retail point-of-sale, and the artisanal fishery sector in Latin America. The market for the Shellcatch solution includes stakeholders seeking traceability, bycatch verification, improvements in the livelihood of fishing communities, and the establishment of a sustainable international seafood market. The goal of the company is to leverage a proven reliable technological solution and service package, which empowers consumers, key players in the supply chain, and ultimately brings tangible benefits to the artisanal fishing community and marine environment. Shellcatch currently works with over 30 fishing communities, 3 governments (national fisheries institutions) and 5 NGOs.

SourceTrace

[SourceTrace](#) eService Everywhere (ESE) Aqua solutions enables visibility of aquaculture value chains to pond level. SourceTrace solutions allow collection of field information near real time and makes it visible to stakeholders in the value chain. SourceTrace's current portfolio of applications include farmer, farm and pond enrollment, hatchery and seed management, pond monitoring, Internal Control System (ICS) for various certifications, input distribution, and procurement. Their "Pond Monitoring" module captures all the data required to monitor the health and growth of the fish in near real time. The product works on handheld devices which are used by field staff and farm managers to capture the information and convey in real time. This improves the overall value chain efficiency, streamlines administrative tasks, and provides powerful analytics including reports, facilitating a cost-effective way to scale up operations in remote areas.

SupplyShift

[SupplyShift](#) is a platform built for flexible industry collaboration and smart sharing of traceability and responsibility information throughout supply chains. The SupplyShift Scorecard Library includes 3,000+ indicators from 25+ standards, and removes all duplication by linking similar indicators across surveys and allowing users complete flexibility to develop assessments. With a novel approach to traceability information, companies can selectively share information with customers, and elect to maintain any information anonymous. SupplyShift's interface can drive improvement and competition in the industry by enabling suppliers to quickly learn about best-in-class practices within their peer group.

ThisFish

[ThisFish](#) is a seafood traceability solution that, to date, encompasses more than a dozen fisheries from North America's Atlantic and Pacific coasts and Europe. Seafood is identified with a unique code, which is linked to traceability data and uploaded to an online system at ThisFish.info. Using computers or smart phones, consumers use the code to trace a product's origins: who caught and processed the fish, when, where, and how. Consumers can even send a message to their fisherman. ThisFish is currently a program of Ecotrust Canada, a charitable non-profit based in Vancouver, Canada.

Trace One

[Trace One](#)'s platform connects the global seafood market and other food industries with the world's largest retailers and consumer packaged goods companies. 20,000 companies globally use the platform representing over \$300B in annual spending. Trace One's technology supports the entire product lifecycle from specification development through labeling. Additionally, Trace One provides supply chain visibility technology to map and monitor the entire supply chain from

“farm to fork.” Trace One solutions have been built around GS1 standards. They enable brand owners to provide consumers with answers to questions such as, “What are the ingredients contained in the products I buy, and do they contain allergens?”; “Where do the ingredients of that product come from?”; “Are the products I’m buying certified, and what certifications are involved with my products?”.

Trace Register

[Trace Register](#)'s platform provides digital full supply chain traceability information about how seafood is harvested, raised, and produced. The company's Traceability Plus analytic software helps producers, distributors, and retailers confidently manage supply chain data to deliver consistently good food to consumers. This platform helps global supply chain partners reduce risk and costs, enabling them to have fewer problems, less waste, higher margins, and more satisfied customers. Founded in 2005, Trace Register has clients in over 56 countries. Currently, about 30% of the top seafood retailers and 70% of the top seafood companies in North America use Trace Register. Trace Register is a privately held company headquartered in Seattle, Washington, with regional offices in South America and Asia.

Traceall Global

[Traceall Global](#) provides real-time traceability, monitoring, and analysis for seafood, food and beverage, and retail sectors. Their passion is to eliminate illegal, unregulated, and unreported fishing globally, provide sustainability within oceans, and provide monitoring for government and businesses. Their UK Government and EU certified Vessel Electronic Logbook software captures catch data monitoring - when, where, and how the seafood was caught and who caught it - transmitting data in real-time to their secure web portal and providing full net to plate traceability. A pilot is currently underway with the Indonesian Government to monitor their fishing fleet to eliminate IUU and slavery. Their portable catch documentation system was developed philanthropically for WWF to help legalize fishing practices for artisanal fishermen. Other solutions including Fishtrace, Supplier Exchange, and Smart Asset Monitoring collect data along supply chains to deliver auditable chain of custody information.

TraceTracker

[TraceTracker](#) is a specialist provider of software and services for supply chain transparency and traceability, as well as for asset tracking, management and condition monitoring.

Vessel Observation and Intelligence Programs

Vessel observation and intelligence programs use satellite and remote sensing data to identify, locate, and monitor fishing vessels and their activity around the globe. These summaries were either provided by the groups themselves or gathered from publically available information on their websites. We have not attempted to independently verify their claims.

Catapult

In collaboration with The Pew Charitable Trusts, the Satellite Applications [Catapult](#) has developed 'Eyes on the Seas', a technology platform that improves ocean sustainability through actionable insight of global fishing activities, legal and illegal. It utilizes multiple data sources, including satellite data, specialist fishing vessel databases and oceanographic data, to surveil vessel activity at sea and alert fisheries analysts to suspicious activity. The analysis provides

independent verification and validation of ‘at sea’ activities and provides information to governments and industry players who are interested in understanding fishing activities in their waters or supply chains in more detail.

SkyTruth

[SkyTruth](#) uses satellite imagery and geospatial data to create credible and compelling resources on a wide range of conservation issues. Since 2001, SkyTruth’s staff has brought decades of experience in remote sensing and big data to their mission of environmental education and engagement. Global Fishing Watch, a partnership between SkyTruth, Oceana and Google, is a new, interactive technology platform that will enable anyone with an Internet connection to see commercial fishing activity anywhere in the world’s oceans in near real-time. It will empower stakeholders by providing transparency, which in turn, will drive the research, advocacy, policy-making, monitoring and enforcement needed for the effective management of fisheries and oceans. Global Fishing Watch can also serve as a key tool in seafood traceability, validating catch documentation and offering a simple and inexpensive way for fishermen to demonstrate they are fishing responsibly.

Trygg Mat

[Trygg Mat Tracking](#) (TMT) provides fisheries intelligence analysis to national authorities and relevant international organizations, in support of enforcement actions and broader improvements in fisheries governance. This is achieved through a combination of information sharing, training and cooperation with various agencies, fisheries intelligence gathering and analysis, vessel tracking, and the development of technology that assists in the collection of information on fisheries crimes. TMT focuses in particular on areas in and near African coastal countries. They provide up to date information available to the public regarding [IUU-listed vessels](#), and also maintain a global database of fishing vessels that is continuously being updated with name changes or other identification markings.

Non-profit Organizations

Non-profit organizations working on seafood issues in North American markets were contacted and asked to provide an overview of their work on seafood traceability. These summaries were either provided by the groups themselves or gathered from publically available information on their websites. We have not attempted to independently verify their claims

Conservation International

[Conservation International \(CI\)](#) is a US-based, global non-profit organization working on science, policy, and partnership with businesses and communities in more than 30 countries worldwide. CI improves food security and livelihoods for fishery-dependent communities by implementing sustainable fisheries solutions built on partnerships and investments from ocean to plate. CI is piloting technologies that improve transparency and seafood traceability in supply chains in Brazil ([+Sustainable Fisheries](#)), Colombia ([EcoGourmet](#)), and Hawai’i ([Hawaii Seafood Month](#) and [Local I’a LLC](#)).

Ecotrust Canada

[Ecotrust Canada](#) is an enterprising non-profit whose purpose is to build the conservation economy. The organization works at the intersection of conservation and community economic

development promoting innovation and providing services for communities, First Nations, and enterprises to green and grow their local economies.

Environmental Justice Foundation

[Environmental Justice Foundation](#) (EJF) is a UK based registered charity working internationally, addressing issues that link environmental security and human rights, focusing on the global south. EJF's campaigns include addressing illegal fishing (IUU) and associated human rights abuses, sustainability, and rights issues associated with shrimp production. EJF's work on fisheries focuses on effective implementation of the European Union IUU Regulation, illegal fishing in the Gulf of Guinea, ending illegal fishing and human rights abuses in the Thai seafood sector, promotion of best practices across the wider Asian region, and an initiative towards greater transparency and traceability in marine fisheries. As part of this project, EJF is calling for a suite of actions: mandatory application of Unique Vessel Identifiers (UVIs) and the development of a Global Record for fishing vessels, the near-term adoption of digital systems in fisheries management, and an end to the exploitation of Flags of Convenience.

FishChoice

[FishChoice.com](#) helps traceability efforts through a B2B membership platform that is based on transparency of seafood product source information. FishChoice aggregates seafood ratings and certifications from the leading assessment organizations. This information is matched with seafood company products and is displayed publicly through an online supplier and product directory. All seafood suppliers are eligible to become members and every product listing includes scientific name, origin, and harvest method(s). The key benefit for suppliers is having the sustainability of their seafood products tracked and maintained by FishChoice. Suppliers use the up-to-date sustainability information of their products for client retention, internal training, and possible new business opportunities. As of year-end 2016, FishChoice.com has nearly 600 supplier members, 4,100+ product listings, approximately 300 species of seafood represented, maintains seafood guides on about 70 species, and has sustainability information on over 2,000 sources of wild and farmed seafood.

FishWise

[FishWise](#) is a non-profit sustainable seafood consultancy that promotes the health and recovery of ocean ecosystems by providing innovative market-based tools to the seafood industry. FishWise has a comprehensive understanding of traceability systems and the benefits and challenges of improving seafood traceability, along with combating IUU fishing and human rights abuses. The distribution of this whitepaper is part of an ongoing effort to share our traceability learnings with a wider audience. As part of our traceability services FishWise: 1) assesses seafood businesses' product tracking procedures, compares and contrasts existing systems with traceability best practices, and provides recommendations on how to improve; 2) conducts risk assessments to identify products that are more likely to be untraceable, associated with illegal harvest or mislabeling, or linked to human rights abuses; and 3) conducts 'traceback exercises' on specific high-risk products to test traceability within supply chains.

Future of Fish

[Future of Fish](#) (FoF) is a non-profit systems change incubator. It provides research, design, and business strategy services to entrepreneurs, non-profits, foundations, and investors, all working to end overfishing. FoF identified and focuses on robust end-to-end traceability in the supply chain and the growth of "Storied Fish." Recent initiatives include: "Getting There From Here," a

white paper highlighting the barriers to and business benefits of traceability adoption, and the formation of a Traceability Technology Pod, comprising 13 traceability technology entrepreneurs working collaboratively. This team of businesses will execute four co-designed initiatives, including two traceability technology pilots and the formation of a trade association. Future of Fish has also used ethnographic research to evaluate technology pilots in artisanal fisheries and consulted on technology strategy to both start-up companies and established non-profits. The organization is currently developing educational resources on traceability technology to help non-profits better advise their seafood industry partners.

Global Food Traceability Center

[The Global Food Traceability Center](#) partners with the global food industry to trace products throughout the supply chain in order to improve food safety, diminish risk, and reduce health and economic consequences to the food system. The GFTC collaborates with key stakeholders in the agri-food system to address research gaps, deliver objective advice to its partners, and provide expertise about global food traceability issues for private benefit and public good.

Greenpeace

[Greenpeace](#)'s Ocean Campaign focuses on ocean threats including industrial fishing, bycatch, human rights at sea, habitat impacts, and works to improve fishery management. Greenpeace evaluates U.S. retailers on traceability and other sustainability issues through its [Carting Away the Oceans](#) reports, and assesses canned tuna brands through its [Tuna Shopping Guide](#). Greenpeace recently released [Sea of Distress](#), its first evaluation of seafood sustainability among U.S. foodservice management companies and broadline distributors. Greenpeace is working to address transshipment at sea, inadequate observer coverage, insufficient monitoring, and control and surveillance regimes, which the organization has identified as major barriers to traceability efforts (see [Turn the Tide](#)). Greenpeace also houses an [IUU vessel blacklist](#) on its website, which combines evidence from its own investigations with a compilation of official listings from around the world.

Gulf of Maine Research Institute

The [Gulf of Maine Research Institute](#) (GMRI) works with all parts of the seafood supply chain - from fishermen to dealers to retailers and foodservice - to advance the ecologic and economic sustainability of the Gulf of Maine region. Their interdisciplinary research team works collaboratively with fishermen and others to study the complex marine environment, while the Sustainable Seafood program works to reward and enable efforts to improve the quality, traceability, and environmental impact of harvesting, growing, procuring, and selling seafood. Together, these efforts capture and maintain data from fishing vessels to inform research, management, and supply chain transparency. While GMRI's work is predominantly focused on the Gulf of Maine, one of the world's most rapidly warming ocean ecosystems, its research and community models offer relevant models for other parts of the country and world.

Gulf of Mexico Reef Fish Shareholders' Alliance

The [Shareholders' Alliance](#) is a non-profit organization that represents the interests of commercial reef fish fishermen and other stakeholders in the Gulf of Mexico. They work to maintain accountability and conservation-based management for the region's fisheries for today and future generations. By working closely with regional managers, state agencies, and federal representatives, the Shareholders' Alliance strives to stabilize and improve fishery management to ensure that they can continue to provide the American public with a sustainable source of

domestically-caught Gulf of Mexico seafood. Everything they do is founded in their belief that conservation and stewardship protect fish populations *and* fishermen's businesses. Members of the Shareholders' Alliance developed the Gulf Wild program - a fully traceable and transparent system of tracking fish from boat to plate that's build upon a foundation of conservation and sustainability.

International Pole & Line Foundation

The [International Pole & Line Foundation](#) (IPNLF) works to develop, support, and promote socially and environmentally responsible pole-and-line and hand-line tuna fisheries around the world. IPNLF believes that robust and verifiable information is needed to secure supply chains as part of a larger sustainability goal. To this end, IPNLF helps one-by-one tuna fisheries meet the growing desire for traceability, and develop tools to share the stories of responsible, traceable fisheries. IPNLF and their [Members](#) recognize the need to develop fishery-specific solutions, and together they are involved in several [traceability projects and programs](#) around the world. For example, there is the Fisheries Information System (FIS) for the Maldives - an integrated web-enabled database to track catch and vessel validation. In Indonesia, IPNLF works with numerous partners to enhance traceability in the supply chain to prove non-IUU fishing, traceability, and vessel legitimacy.

International Seafood Sustainability Foundation

The [International Seafood Sustainability Foundation](#) (ISSF) is a non-profit global coalition that seeks to undertake science-based initiatives for the long-term conservation and sustainable use of tuna stocks. Their objective is to improve the sustainability of global tuna stocks by developing and implementing verifiable, science-based practices, commitments, and international management measures that result in tuna fisheries meeting the MSC certification standard without conditions, and becoming the industry standard for vessel owners, traders, processors, and marketers. ISSF will cooperate with and support Regional Fisheries Management Organizations (RFMOs), and vigorously advocate to RFMO members for the adoption and implementation of science-based management measures so that tuna stocks and their ecosystem are managed comprehensively and sustainably.

Marine Conservation Institute

[Marine Conservation Institute](#) is a team of highly experienced marine scientists and environmental policy advocates dedicated to conserving marine biodiversity for today and future generations. The organization's overarching goal is to help the world create an urgently needed worldwide system of strongly protected areas—the [Global Ocean Refuge System](#) (GLORES)—a strategic, cost-effective way to ensure future diversity and abundance of marine life. As part of that effort, they have developed the MPAtlas at www.mpatlas.org with a comprehensive online database and mapping tool of existing and planned marine protected areas (MPAs). The organization has worked on U.S. laws affecting IUU or pirate fishing since this illegal activity often targets MPAs, results in degradation of marine environments around the world and food insecurity for those who depend on sustainable fisheries.

Monterey Bay Aquarium

The [Monterey Bay Aquarium Seafood Watch® program](#) helps consumers and businesses choose seafood that's fished or farmed in ways that protect sea life and habitats, now and for future generations. [Seafood Watch provides science-based recommendations](#) - indicating which seafood items are *Best Choices* or *Good Alternatives*, and which ones to *Avoid* - through its

[consumer guides](#), [website](#) and [app](#) to help raise public awareness about sustainable seafood issues. Leading U.S. seafood buyers, distributors, retailers and chefs also rely on Seafood Watch to guide purchasing, which advances sustainable fishing and aquaculture operations and incentivizes others to improve. Seafood Watch's work with governments, international colleagues and regional fisheries management organizations make it an integral part of ongoing efforts to address international supply chain issues, such as traceability; human rights abuses; and illegal, unreported, and unregulated fishing.

National Aquarium

[National Aquarium](#) builds on a 35-year history of conservation initiatives that provide real solutions for protecting marine life, ecosystems and aquatic communities. They participate in research efforts to confront ocean conservation issues and advocate for smarter policies. The aquarium supports efforts to ensure imported aquacultured products are held to the same high standards as U.S. products. [Seafood Smart](#) an initiative focused on stimulating consumer demand for responsible aquacultured products by advancing awareness, reinforcing healthy stories, and connecting responsibly farmed product to consumer markets. The Aquarium views traceability as crucial means to achieve sustainable aquaculture, but traceability alone is not enough. The National Aquarium will also soon be conducting a complete evaluation of the traceability of their food sources – from animal feed to the food they serve in their restaurants.

The Nature Conservancy

The mission of [The Nature Conservancy](#) is to conserve the lands and waters on which all life depends. To that end, the Conservancy actively tests new harvesting techniques and models for sustainable fisheries, many of which benefit from emerging technology. One of the more difficult aspects of fisheries management is the collection of good data, particularly location data, in a manner that allows for in-season adaptive management. To address this need, the Conservancy created a mobile application called [eCatch](#) that provides a simple way for fishermen to collect, map, and share their harvest information. In the future, this technology has the potential to complement traceability by providing a means to verify the location, content, and ecological context of catch information at sea.

New England Aquarium

[New England Aquarium](#)'s Sustainable Seafood Program works with some of the world's largest seafood retailers and suppliers to encourage the sustainable development of farmed and wild-caught seafood resources. The Aquarium advises these companies on issues related to seafood sustainability and facilitates proactive changes along their supply chains to promote marine conservation. Developing a variety of strategies and tools to enhance transparency and traceability is a critical component of the Aquarium's efforts with corporate partners and their supply chains. Such guidance can help companies meet their sustainability commitments by ensuring that seafood products are caught or farmed legally using environmentally responsible methods. Strategies include: improving companies' internal traceability systems; working through the supply chain to collect and verify product information, and; engagement of businesses, policy makers, scientists, and conservation colleagues in support of policies and other strategies to combat IUU fishing.

Oceana

[Oceana](#)'s Seafood Fraud Campaign, launched in 2011, works to stop seafood fraud and ensure that all seafood sold in the U.S. is safe, legally caught, and honestly labeled. Oceana has

conducted investigations of fish, shrimp, crab cakes, and salmon in retail markets and restaurants in the U.S., revealing that one third of the seafood tested was mislabeled. To help stop seafood fraud and illegal fishing, Oceana is working to change U.S. policies to require more transparency and traceability in the seafood supply chain, including requiring catch documentation for all seafood, full chain traceability, and more information provided to seafood consumers at the final point of sale.

Ocean Outcomes

[Ocean Outcomes](#) (O2) is a science-based sustainable seafood consultancy working hand in hand with commercial fisheries to help them become more sustainable. O2's work addresses the full range of major fishery challenges contributing to the global fisheries crisis, such as IUU, overfishing, depletion of non-target stocks, habitat impacts, and management system issues. As a traceability solution to support FIPs and third-party certification in Russia, O2 piloted a Catch Tracking System (CTS), implementing best practices in self-reporting and verification of the paper trail to close loopholes in the "first mile," from producers to processors. By following the CTS protocol companies capture and upload information to assure customers that they are receiving product traceable back to the source fishery.

Pew Environment Group

[The Pew Charitable Trusts'](#) global campaign to end illegal fishing is working to set up a global fisheries enforcement system to combat IUU fishing. Pew is working to build the international capacity for generating critical analysis and intelligence on IUU fishing, developing ways for nations to share information about IUU fishing, and putting critical information and tools in the hands of enforcement authorities worldwide. Pew will continue to assist in efforts by national and international bodies, including Regional Fisheries Management Organizations, to implement the Port State Measures Agreement, uniquely identify fishing vessels and track them globally. Pew has an increased focus on the use of technology to combat illegal fishing.

SeaChoice

[SeaChoice](#), Canada's most comprehensive sustainable seafood program is about finding solutions for healthy oceans. SeaChoice works with Canada's leading retailers and seafood distributors to help guide robust traceability solutions in the Canadian marketplace. SeaChoice facilitates traceability solutions for retailer partners through use of traceability tools where available or credible eco-certifications which hold robust chain of custody. Launched in 2006, SeaChoice was created to help Canadian businesses and shoppers take an active role in supporting sustainable fisheries and aquaculture at all levels of the seafood supply chain. Working in collaboration with the Monterey Bay Aquarium's acclaimed Seafood Watch program, SeaChoice undertakes science-based seafood assessments, provides informative resources for consumers, and supports businesses through collaborative partnerships. The SeaChoice program is operated by the Canadian Parks and Wilderness Society, David Suzuki Foundation, Ecology Action Centre and Living Oceans Society.

Sustainable Fisheries Partnership

[Sustainable Fisheries Partnership](#) (SFP) provides assessments of sustainability and improvement needs for source fisheries to seafood buyers. SFP is working in a pod led by Future of Fish that includes technology companies focused on developing global solutions for seafood traceability. SFP's public database, [FishSource.org](#), is one of the world's largest catalogs of source fishery information for wild harvest seafood and contains over 2,000 source fisheries. FishSource.org

maintains a standard for identifying a source fishery that could be used in validating fisheries in traceability systems. SFP is working with many collaborators to complete design and development of this source fishery validation tool so this fundamental information can flow through the supply chain. Going forward SFP is working to expand this same level of identification to watersheds for aquaculture production and will embark on a Fishery Improvement Project (FIP) traceability pilot.

World Wildlife Fund

[World Wildlife Fund](#) (WWF) supports sustainable fishing and good governance in geographic places such as the Arctic, the Indian Ocean, the Pacific, the Southern Cone, and on the high seas. WWF focuses efforts on reducing the impact of fishing that is making a considerable footprint on the world's most ecologically important marine ecoregions and conserving the most commercially valuable species such as tuna and whitefish. WWF also works with [private partners](#) to push market demand for sustainable seafood. WWF has worked to advance seafood traceability through crafting guidance documents such as [Traceability Principles for Wild-Caught Fish Products](#) and [Recommendations for a Global Framework to Ensure the Legality and Traceability of Wild-Caught Fish Products](#), and participating in various collaborative projects aimed at advancing industry-wide traceability best practices such as the Global Dialogue on Seafood Traceability.

Other Companies and Programs

These are organizations that do not fall within any of the above categories, but that work on seafood traceability. These summaries were either provided by the groups themselves or gathered from publically available information on their websites. We have not attempted to independently verify their claims.

Arnold & Porter LLP

[Arnold & Porter LLP](#) advises global companies in high-risk industries on anti-corruption and supply chain security compliance and investigations. The firm's natural resources trade practitioners include a former federal prosecutor who headed the highly publicized Lacey Act investigation and prosecution of the Arnold Bengis international fish smuggling ring, a former high-level State Department official who focuses on international trade and supply chain issues, and a number of attorneys who worked at the Department of Justice's Environment and Natural Resources Division. Their lawyers bring a depth of experience in U.S. trade law, corporate compliance programs, environmental law, and criminal and civil litigation.

CLS America

[CLS America](#) is a satellite data communications company that has been a proud partner of fishermen and of NOAA for over 20 years. The company tracks fishing vessels with their [THORIUM VMS system](#), a product they developed to make VMS an important part of the business of fishing, rather than just another rule to comply with. With Thorium, vessels can track their vessel as well as their fishing activity and catch. They can correlate catch information with a variety of ocean and weather conditions to optimize fishing effort. They can communicate in real time with fish houses or customers, track fish hold temperatures and other key parameters on board, and even trace individual fish.

European Traceability Institute

The [European Traceability Institute](#) (ETI) is an independent private institution based in Brussels, Belgium that assists organizations worldwide to implement traceability and profitably provide safe and sustainably made food and other products via efficient supply chains. Its services are designed to be used as tools that enable organizations, regardless of geography, size or sector, to introduce effective traceability and recall systems and build such capacity both within and outside the organization. ETI assesses existing needs and systems, helping organizations to understand their key strengths and weaknesses, and to implement traceability by integrating existing initiatives, removing duplication and identifying gaps. When fully implemented, the ETI Model, Trace-Certified™ program and associated Professional Services result in a traceability system that is capable to cost-efficiently support multiple business objectives such as consumer and patient safety, product differentiation, sustainability, supply chain management, and brand protection.

GS1

[GS1 US](#), a member of GS1®, is an information standards organization that brings industry together to solve supply chain problems through the adoption of GS1 Standards. GS1 U.S. helps companies streamline operations based on the use of global standards to identify, capture, and share product information from source to consumption. To better track and trace food, the industry needs collaboration and a “whole-chain” approach to the supply chain. Enabling whole-chain traceability involves linking internal proprietary traceability systems with external systems through the use of one global language—the GS1 System of Standards—across the supply chain. GS1 Standards enable trading partners in the supply chain to talk to one another through the identification encoded in barcodes. GS1 U.S. seafood traceability resources include: the [U.S. Seafood Traceability Implementation Guide](#) and the [Seafood Traceability Proof of Concept Project Overview](#), both available at www.gs1us.org/seafood.

Oceans 5 Alliance

[Oceans 5](#) is a global funder's collaborative, comprised of new and experienced philanthropists, committed to protecting the five oceans of the planet. The group collectively focuses its investments and support on large-scale, opportunistic projects and campaigns aimed at significantly expanding marine reserves and constraining overfishing. It supports several projects to control illegal fishing and improve seafood traceability in the United States, Europe, and Central America.

Resiliensea

[Resiliensea Group](#) is an advisory firm dedicated to helping the seafood industry improve performance across the entire footprint of seafood; product sourcing and development, sustainable program development, social issues, governmental relations, marketing, category management and analysis, market development, training, and consumer outreach. Their primary purpose is to foster improved cooperation and progress among all stakeholders for the betterment of the industry. The company has also been expanding into additional areas such as social compliance and traceability. For social compliance, they collaborate with specialists like Sustainability Incubator to help companies utilize their tools to identify potential risks and take actions to address those risks. For traceability, they are working with program developers and the NGO community to incorporate a robust set of common rules that will promote innovation and interoperability between systems.

SkyMate

The [SkyMate](#) I1500VMS is designed for commercial fishermen and is type-approved across all NOAA fisheries. SkyMate sends position reports and system status updates at required intervals and gives users access to sea surface temperatures, weather forecasts, fish prices, email, and other services. SkyMate systems require less than an hour for installation and has global coverage for all services.

Appendix II. Resources on Traceability

Category	Publication	Link	Medium
Resources and Guidance	Project to Develop an Interoperable Seafood Traceability Technology Architecture: Issues Brief	http://onlinelibrary.wiley.com/doi/10.1111/1541-4337.12187/full	Publication
Resources and Guidance	Assessing the Value and Role of Seafood Traceability from an Entire Value-Chain Perspective	http://onlinelibrary.wiley.com/doi/10.1111/1541-4337.12130/epdf	Publication
Resources and Guidance	Bringing Fishing Vessels out of the Shadows	https://www.fishwise.org/images/pdfs/out_of_the_shadows_ejf_fishwise.pdf	Publication
Resources and Guidance	Getting There from Here: A Guide for Companies Implementing Seafood Supply-Chain Traceability Technology	http://futureoffish.org/sites/default/files/docs/resources/fofs-traceability_report-final_0.pdf	Publication
Resources and Guidance	Grocery Manufacturers Association Food Supply Chain Handbook	http://www.gmaonline.org/downloads/technical-guidance-and-tools/GMA_SupplyChain2.pdf	Publication
Resources and Guidance	The Untapped Potential of Story to Sell Seafood	http://futureoffish.org/sites/default/files/docs/resources/Storied%20Fish%20Report_Aug2016.pdf	Publication
Resources and Guidance	Traceability 101 Toolkit	http://futureoffish.org/content/traceability-101	Web
Resources and Guidance	Traceability for Seafood U.S. Implementation Guide	http://www.aboutseafood.com/sites/all/files/FINAL%20Seafood%20Trace%20Guide_v1.1.pdf	Publication

Category	Publication	Link	Medium
Resources and Guidance	Deceptive Dishes: Seafood Swaps Found Worldwide	http://usa.oceana.org/sites/default/files/global_fraud_report_final_low-res.pdf	Publication
Traceability and Anti-IUU Fishing Best Practice Documents	An Advisory Note for the UK Supply Chain on How to Avoid Illegal, Unreported and Unregulated (IUU) Fishery Products	http://ejfoundation.org/sites/default/files/public/EJF-Advisory-Note-low-res-final.pdf	Publication
Traceability and Anti-IUU Fishing Best Practice Documents	Recommendations for the Global Framework to Ensure the Legality and Traceability of Wild-Caught Fish Products	http://solutions-network.org/site-legaltraceablefish/files/2015/03/EPLAT_FinalReport_March2015_Webview.pdf	Publication
Traceability and Anti-IUU Fishing Best Practice Documents	Traceability Principles for Wild-Caught Fish Products	http://assets.worldwildlife.org/publications/796/files/original/WWF_Traceability_Principles_for_Wild-Caught_Fish_April_2015.pdf?1430410438&_ga=1.161806972.1776882823.1455309792	Publication
Government Initiatives	IUUWatch.eu	http://www.iuuwatch.eu	Web
Government Initiatives	Improving International Fisheries Management	http://www.fisheries.noaa.gov/ia/iuu/msra_page/2015noaareptcongress.pdf	Publication
Government Initiatives	Presidential Initiative on Combating Illegal, Unreported, and Unregulated (IUU) Fishing and Seafood Fraud	http://www.nmfs.noaa.gov/ia/iuu/taskforce.html	Web
Government Initiatives	Port State Measures Agreement ratification progress mapped by country	http://www.pewtrusts.org/en/multimedia/data-visualizations/2014/psma	Web

Category	Publication	Link	Medium
Tools	Global Fishing Watch	http://globalfishingwatch.org	Web
Tools	Seafood Traceability Financial Tool	https://seafoodtraceability.org	Web
Tools	Seafood Consumer Preference Tool	http://info.ift.org/download-the-GFTC-Seafood-Consumer-Preference-Tool?Preview=true	Web
Tools	Project Eyes on the Seas	http://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2015/03/project-eyes-on-the-seas	Web
Tools	WhoFishesFar	http://www.whofishesfar.org	Web
Tools	Combined IUU Vessel List	http://iuu-vessels.org/iuu/	Web
Tools	Conservation of Antarctic Marine Living Resources	https://www.ccamlr.org/en/compliance/illegal-unreported-and-unregulated-iuu-fishing	Web
Tools	Commission for the Conservation of Southern Bluefin Tuna, Record of Authorized Vessels	http://www.ccsbt.org/site/authorised_vessels.php	Web
Tools	Directorate of Fisheries, IUU List	http://www.fiskeridir.no/english/fisheries/iuu-list	Web
Tools	European Union	http://ec.europa.eu/fisheries/cfp/illegal_fishing/index_en.htm	Web
Tools	Greenpeace Blacklist	http://www.greenpeace.org/international/en/campaigns/oceans/pirate-fishing/Blacklist1/Browse-Greenpeace-Blacklist/	Web
Tools	Inter-American Tropical Tuna Commission, Current IUU Vessel List	http://www.iattc.org/VesselRegister/IUU.aspx?Lang=en	Web

Category	Publication	Link	Medium
Tools	International Commission for the Conservation of Atlantic Tunas, IUU Vessel List	http://www.iccat.int/en/IUU.asp	Web
Tools	Indian Ocean Tuna Commission, IUU List	http://www.iotc.org/vessels#iuu	Web
Tools	Northwest Atlantic Fisheries Organization	https://www.nafo.int/Fisheries/IUU	Web
Tools	Northeast Atlantic Fisheries Commission, IUU Black List	http://www.neafc.org/blist	Web
Tools	PEW Environmental Group, Port State Performance	http://www.pewtrusts.org/en/research-and-analysis/reports/2009/12/08/port-state-performance	Web
Tools	Southeastern Atlantic Fisheries Organization, IUU Vessel List	http://www.seafo.org/media/eb2fe33c-8253-49ea-8f4f-09da1b20a4eb/SEAFOweb/pdf/IUU/IUU_list_2017_pdf	Publication
Tools	Western and Central Pacific Fisheries Commission, WCPFC IUU Vessel List	http://www.wcpfc.int/vessels	Web
Tools	United Nations Food and Agriculture Organization Global Record of Fishing Vessels	http://www.fao.org/fishery/global-record	Web

Appendix III. Contacts

Organization/ Company Name	Organization Type	Contact Name	Contact Email	Website
ACGT, Inc.	DNA Testing Companies	Semyon Rubinchik	semyon_rubinchik@acgti nc.com	www.acgtinc.com
Alaska Responsible Fisheries Management Program	Environmental and Traceability Certifications	Susan Marks	smarks@alaskaseafood.o rg	http://alaskaseafood.org/
Applied Food Technologies	DNA Testing Companies	LeeAnn Applewhite	lapplewhite@appliedfoo dtechnologies.com	http://appliedfoodtechnologies.com/
Aquaculture Stewardship Council	Environmental and Traceability Certifications	Bas Geerts	info@asc-aqua.org	http://www.asc-aqua.org
Arnold & Porter LLP	Other Companies and Programs	Marcus Asner	marcus.asner@aporter.c om	http://www.arnoldporter.com
BackTracker	Traceability Programs and Technology Solutions	Michael Carroll	mcarroll@vertexeng.com	www.backtrackerinc.com
BonifIDcatch	DNA Testing Companies	Joan Stader	joan@bonafidcatch.com	http://www.bonafidcatch.com
Catapult	Vessel Observation and Intelligence Programs	Corinne Green	corinne.green@sa.catap ult.org.uk	https://sa.catapult.org.uk/home
CLS America	Vessel Monitoring Systems	Michael Kelly	mkelly@clsamerica.com	www.thoriumvms.com

Organization/ Company Name	Organization Type	Contact Name	Contact Email	Website
Conservation International	Non-profit Organizations	Jack Kittinger	jkittinger@conservation.org	www.conservation.org
Dynamic Systems, Inc.	Traceability Programs and Technology Solutions	Alison Falco	alisonF@dynamic-systemsinc.com	http://dynamic-systemsinc.com/software/seafood/
Ecotrust Canada	Non-profit Organizations	Tasha Sutcliffe	tasha@ecotrust.ca	http://ecotrust.ca/
Environmental Defense Fund	Non-profit Organizations	Roxanne Nanninga	rnanninga@edf.org	www.EDF.org
Environmental Justice Foundation	Non-profit Organizations	Steve Trent	steve.trent@ejfoundation.org	http://www.ejfoundation.org
European Traceability Institute	Other Companies and Programs	Miodrag Mitic	info@traceability-institute.eu	http://traceability-institute.eu/
Fair Trade Certified Seafood	Environmental and Traceability Certifications	Ashley Apel	aapel@fairtradeusa.org	http://fairtradeusa.org/certification/producers/seafood
FishChoice	Non-profit Organizations	Justin Boevers	justin@fishchoice.com	http://www.fishchoice.com/
Fish Trax™	Traceability Programs and Technology Solutions	Gil Sylvia	gil@fishtrax.org, gil.sylvia@oregonstate.edu	www.fishtrax.org
FishWise	Non-profit Organizations	Mariah Boyle	m.boyle@fishwise.org	http://www.fishwise.org

Organization/ Company Name	Organization Type	Contact Name	Contact Email	Website
Food Alliance	Environmental and Traceability Certifications	Matthew Buck	matt@foodalliance.org	http://foodalliance.org/shellfish-farms/
Food Marketing Institute		Rick Stein	rstein@fmi.org	www.fmi.org
Frequentz	Traceability Programs and Technology Solutions	John McPherson	john.mcpherson@frequentz.com	http://frequentz.com/
Friend of the Sea	Environmental and Traceability Certifications	Paolo Bray	paolobray@friendofthesea.org	http://www.friendofthesea.org
fTrace	Traceability Programs and Technology Solutions	Mark Zeller	zeller@gs1-germany.de	http://www.ftrace.com/en/us/about
Future of Fish	Non-profit Organizations	Keith Flett	kflett@futureoffish.org	www.futureoffish.org
Global Aquaculture Alliance BAP	Environmental and Traceability Certifications	Daniel Lee	dan.lee@gaalliance.org	http://www.gaalliance.org
Global Food Traceability Center	Non-profit Organizations	Will Fisher	wfisher@ift.org	http://www.globalfoodtraceability.org
GLOBALG.A.P.	Environmental and Traceability Certifications	Valeska Weymann	weymann@globalgap.org	http://www.globalgap.org/
Greenpeace	Non-profit Organizations	John Hocevar	john.hocevar@greenpeace.org	http://www.greenpeace.org/usa/oceans/

Organization/ Company Name	Organization Type	Contact Name	Contact Email	Website
GS1	Other Companies and Programs	Michele Southall	msouthall@gs1us.org	http://www.gs1us.org/seafood
Gulf of Maine Research Institute	Non-profit Organizations	Jen Levin	jlevin@gmri.org	www.gmri.org
Gulf of Mexico Reef Fish Shareholders' Alliance	Non-profit Organizations	Eric Brazer	eric@shareholdersalliance.org	http://shareholdersalliance.org/
INSCATECH	Traceability Programs and Technology Solutions	Mitchell Weinberg	mitchellweinberg@inscatech.com	www.inscatech.com http://www.genufish.com/
Insite Solutions	Traceability Programs and Technology Solutions	Insite Solutions	info@insite-solution.com	www.insite-solution.com
InstantLabs	DNA Testing Companies	Neil Sharma	nsharma@instantlabs.com	www.instantlabs.com
Intact Systems	Traceability Programs and Technology Solutions	Thomas Lorber	thomas.lorber@intact-systems.com	http://www.intact-systems.com/integrity-management-solutions/
International Organization for Standardization	Environmental and Traceability Certifications	International Organization for Standardization (ISO)	central@iso.org	http://www.iso.org/iso/home.html
International Pole & Line Foundation	Non-profit Organizations	Adam Baske	adam.baske@ipnlf.org	http://ipnlf.org

Organization/ Company Name	Organization Type	Contact Name	Contact Email	Website
International Seafood Sustainability Foundation	Non-profit Organizations	Mary Beth Taylor	mbtaylor@iss- foundation.org	http://iss-foundation.org/
IQMI	Traceability Programs and Technology Solutions	Julian Hawkins	julian@iqmi.ca	http://iqmi.ca/
Marine Conservation Institute	Non-profit Organizations	Michael Gravitz	michael.gravitz@marine- conservation.org	<a href="http://www.marine-
conservation.org/">http://www.marine- conservation.org/
Marine Stewardship Council	Environmental and Traceability Certifications	Product Integrity Team	productintegrity@msc.or g	http://www.msc.org/
mFish	Traceability Programs and Technology Solutions	Angela Hariche	angela@withtone.com	<a href="http://www.withtone.co
m/mfish">http://www.withtone.co m/mfish
Monterey Bay Aquarium	Non-profit Organizations	Brian Albaum	balbaum@mbayaq.org	www.seafoodwatch.org
MRAG	Certification Accreditation Bodies and Auditors	Duncan Souter, Emi Katoh	dsourer@mragsiapacific .com.au, e.katoh@mragsiapacific.co.uk	http://www.mragasiapacific.com.au/Seafood-Traceability http://www.mragamericas.com/services/seafood-traceability http://mragsiapacific.co.uk/services/seafood-certification-traceability-improvement
National Aquarium	Non-profit Organizations	Tj Tate	info@aqua.org	http://aqua.org

Organization/ Company Name	Organization Type	Contact Name	Contact Email	Website
New England Aquarium	Non-profit Organizations	Joel Southall	jsouthall@neaq.org	http://www.neaq.org www.andersoncabotcenterforoceanlife.org
Ocean Outcomes	Non-profit Organizations	Brian Caouette	brian@oceanoutcomes.org	http://www.oceanoutcomes.org/
Oceana	Non-profit Organizations	Beth Lowell	blowell@oceana.org	www.oceana.org
Oceans 5 Alliance	Other Companies and Programs	Chuck Fox	chuck@oceansfive.org	http://www.oceans5.org/
Pelagic Data Systems	Traceability Programs and Technology Solutions	Dave Solomon	info@pelagicdata.com	www.pelagicdata.com
Pew Environment Group	Non-profit Organizations	Joseph Zelasney	jzelasney@pewtrusts.org	http://www.pewtrusts.org/our_work_detail.aspx?id=940
Point 97	Traceability Programs and Technology Solutions	Charles Steinback	charles@pointnineseven.com	http://pointnineseven.com/
Resiliensea	Other Companies and Programs	Phil Gibson	pgibson@resiliensea.com	http://www.resiliensea.com/
SAI Global	Certification Accreditation Bodies and Auditors	David Garforth	david.garforth@saiglobal.com	www.saiglobal.com/assurance

Organization/ Company Name	Organization Type	Contact Name	Contact Email	Website
Scientific Certification Systems	Certification Accreditation Bodies and Auditors	Jason Swecker	jswecker@scsglobalservi ces.com	<a href="https://www.scsglobalser
vices.com">https://www.scsglobalser vices.com
Scoring Ag	Traceability Programs and Technology Solutions	William Kanitz	info@scoringag.com	<a href="https://www.scoringag.co
m//scoringag/3/Ag.cfm?sf
a=main.main">https://www.scoringag.co m//scoringag/3/Ag.cfm?sf a=main.main
SeaChoice	Non-profit Organizations	Lana Gunnlaugson	info@seachoice.org	www.SeaChoice.org
Seafood Task Force		Martin Thurley	secretariat@shrimptaskf orce.global	<a href="http://www.seafoodtaskforce.gl
obal">www.seafoodtaskforce.gl obal
Seasoft Software	Traceability Programs and Technology Solutions	Jim Levy	info@caisoft.com	www.caisoft.com/seasoft
Shellcatch	Traceability Programs and Technology Solutions	Alfredo Sfeir	alfredo.sfeir@shellcatch. com	<a href="http://www.shellcatch.co
m/">http://www.shellcatch.co m/
SkyMate	Vessel Monitoring Systems	Craig Myers	cmyers@SkyMate.com	<a href="https://www.skymate.co
m/index.html">https://www.skymate.co m/index.html
SkyTruth	Vessel Observation and Intelligence Programs	David Manthos	info@skytruth.org	www.skytruth.org
SourceTrace	Traceability Programs and Technology Solutions	Dr. Venkat Maroju	vmaroju@sourcetrace.co m	<a href="http://www.sourcetrace.c
om">http://www.sourcetrace.c om

Organization/ Company Name	Organization Type	Contact Name	Contact Email	Website
SupplyShift	Traceability Programs and Technology Solutions	James Barsimantov	jbarsimantov@supplyshift.net	www.supplyshift.net
Sustainable Fisheries Partnership	Non-profit Organizations	Bryan Szeliga	bryan.szelliga@sustainablefish.org	http://sustainablefish.org http://www.fishsource.org/
The Nature Conservancy	Non-profit Organizations	Matt Merrifield	mmerrifield@tnc.org	http://www.nature.org
Therion International, LLC	DNA Testing Companies	William Gergits	gergits@theriondna.com	http://www.theriondna.com/
ThisFish	Traceability Programs and Technology Solutions	Eric Enno Tamm	eric@thisfish.info	http://thisfish.info
Trace One	Traceability Programs and Technology Solutions	Mark Hudson	mark.hudson@traceone.com	www.traceone.com
Trace Register	Traceability Programs and Technology Solutions	Sunshine Morrison or Alex Miller	sunshine@radiancecom.com, amiller@traceregister.com	http://www.traceregister.com
TraceAll Global	Traceability Programs and Technology Solutions	Annamarie Taylor, Alan Steele	annamarie.taylor@traceallglobal.com, alan.steele@traceall.co.uk	http://traceall.co.uk

Organization/ Company Name	Organization Type	Contact Name	Contact Email	Website
TraceTracker	Traceability Programs and Technology Solutions	Helge Kittelsen	tt- canada@tracetracker.co m	http://www.tracetracker.com
TRUfish	DNA Testing Companies	Roxanne Nanninga	info@TRUfish.org	www.TRUfish.org
Trygg Mat	Vessel Observation and Intelligence Programs	Duncan Copeland	dcopeland @tm-tracking.org	http://www.tm-tracking.org/
World Wildlife Fund	Non-profit Organizations	David Schorr	david.schorr@wwfus.org	http://wwf.panda.org/

Appendix IV. Works Cited

Agnew, D., et al. (2009) *Estimating the Worldwide Extent of Illegal Fishing*. PLoS ONE. Available at: <http://www.plosone.org/article/info:doi/10.1371/journal.pone.0004570>

Animal Legal and Historical Center (ALHC) (2017) Lacey Act: Related Cases. Michigan State University, College of Law. Website. Available at: <https://www.animallaw.info/cases/topic/lacey-act>

Bartholomew, N. (2012) *Sustainable Seafood Toolkit: A Guide for Retailers*. Food Marketing Institute (FMI). Available at: https://www.fmi.org/docs/sustainability/fmi_sustainable_seafood_toolkit_may_2012.pdf?sfvrsn=2

Bhatt, T., et al. (2016) *Project to Develop an Interoperable Seafood Traceability Technology Architecture: Issue Brief*. Comprehensive Reviews in Food Science and Food Safety. 15: 392-429. Available at: <http://onlinelibrary.wiley.com/doi/10.1111/1541-4337.12187/abstract>

Blancou, J. (2001) *A history of the traceability of animals and animal products*. Rev Sci Tech Aug; 20(2):413-425.

Boston Globe (2011) *Globe Investigation Finds Widespread Seafood Mislabeling*. Available at: http://www.boston.com/business/specials/fish_testing/

Brashares, J., et al. (2014) *Wildlife decline and social conflict*. Science 345 (6195) 376-378. DOI: 10.1126/science.1256734.

California Environmental Associates (CEA) (2015) *Progress toward Sustainable Seafood – By the Numbers*. Packard Foundation, Seafood Metrics Report. June 2015. Available at: <http://speakingofseafood.org/wp-content/uploads/2016/08/Progress-towards-Sustainable-Seafood-June-2015.pdf>

Canadian Food Inspection Agency (CFIA) (2012) *Improved Food Inspection Model: Proposed Draft*. Available at: <http://www.inspection.gc.ca/about-the-cfia/accountability/inspection-modernization/proposed-draft/eng/1342549427433/1342549854104>

Center for Disease Control and Prevention (CDC) (2010) *Gulf Oil Spill 2010: Seafood Safety Following the Gulf Oil Spill*. Available at: http://www.bt.cdc.gov/gulfoilspill2010/seafood_safety.asp

CDC (2011) CDC and Food Safety. Website. Available at: <http://www.cdc.gov/foodsafety/cdc-and-food-safety.html>

Charlebois, S., et al. (2014) *Comparison of global food traceability regulations and requirements*. Comprehensive Reviews in Food Science and Food Safety 13.5: 1104-1123.

Clarke, S. (2009) *Understanding China's Fish Trade and Traceability*. TRAFFIC East Asia. Available

at: http://www.trafficj.org/publication/09_understanding_china_fish.pdf

Conservation Alliance for Seafood Solutions (2016) *The Common Vision for Sustainable Seafood*. Available at: <http://www.solutionsforseafood.org/projects/common-vision/>

Consumer Reports (2011) *What fish is on your plate? Probably not the one you ordered*. Available at: <http://news.consumerreports.org/money/2011/10/what-fish-is-on-your-plate-probably-not-the-one-you-ordered.html>

D'Amico et al. (2014) *Seafood traceability issues in Chinese food business activities in light of the European provision*. Food Control 35, 1: 7-13. Available at: <http://www.sciencedirect.com/science/article/pii/S0956713513003125>

Delhaize Group (2015) *Sustainability progress report 2015*. Available at: <https://sustainabilityreport.delhaizegroup.com/group-performance/gp-sustainable-private-brands>

Department of Fisheries and Oceans Canada (DFO) (2012) *Canada's Catch Certification Program*. Available at: <http://www.dfo-mpo.gc.ca/fm-gp/ccp-pcc/index-eng.htm>

Di Pinto, A et al. (2015). *Species identification in fish fillet products using DNA barcoding*. Fisheries Research, 170, 9-13.

EJF and FishWise (2013) *Bringing Fishing Out of the Shadows*. Briefing Paper. Available at: http://www.fishwise.org/images/pdfs/out_of_the_shadows_ejf_fishwise.pdf

ELAW: Lewis & Clark Law School's Environmental Law (2016) *United States v. Ertsgaard*. 222 F.3d 615 (9th Cir. 2000) Available at: <http://elawreview.org/case-summaries/united-states-v-ertsgaard/>

EPLAT (2015) *Recommendations for a global framework to ensure the legality and traceability of wild-caught fish products: final report*. Expert Panel on Legal and Traceable Wild Fish Products. Available at: http://solutions-network.org/site-legaltraceablefish/files/2015/03/EPLAT_FinalReport_March2015_Webview.pdf

European Union (EU) regulation 104/2000. Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:017:0022:0052:EN:PDF>

European Union regulation 178/2002. Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:031:0001:0024:EN:PDF>

European Commission (2014) *European Union and Japan join forces against illegal fishing*. European Commission. Available at: http://ec.europa.eu/archives/commission_2010-2014/damanaki/headlines/press-releases/2012/07/20120711_en.htm.

European Commission (2016) *The EU rules to combat illegal fishing (IUU)*. European Commission. Available at: http://ec.europa.eu/fisheries/cfp/illegal_fishing/info_en.

European Community Commission Regulation 2065/2001. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:278:0006:0006:EN:PDF>

Food and Agriculture Organization of the United Nations (FAO) (2009) *Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing*. FAO Fisheries and Aquaculture Department. Available at: <http://www.fao.org/fishery/psm/en>

FAO (2012) *The State of World Fisheries and Aquaculture*. FAO Fisheries and Aquaculture Department. Available at: <http://www.fao.org/docrep/016/i2727e/i2727e00.htm>

FAO (2012b) *Fisheries and Aquaculture Report No. 996. Committee on Fisheries: Report of the thirteenth session of the Sub-Committee on Fish Trade*. FAO Fisheries and Aquaculture Department. Available at: <http://www.fao.org/docrep/015/i2755t/i2755t00.pdf>

FAO (2013) Unique Vessel Identifier (UVI) – Global Record. FAO Fisheries and Aquaculture Department. Updated 16 July 2013. Available at: <http://www.fao.org/fishery/topic/18021/en>

FAO (2014a) *The State of World Fisheries and Aquaculture*. FAO Fisheries and Aquaculture Department. Available at: <http://www.fao.org/3/a-i3720e.pdf>

FAO (2014b) *Review and Analysis of Current Traceability Practices*. FAO Committee on Fisheries, Sub-Committee on Fish Trade. Bergen, Norway, 24-28 February 2014. Available at: <http://www.fao.org/cofi/30159-03016d7904191838c67f5d7da55b3430f.pdf>

FAO (2016a) *The State of World Fisheries and Aquaculture*. FAO Fisheries and Aquaculture Department. Available at: <http://www.fao.org/3/a-i5555e.pdf>

FAO (2016b) Global Record of Fishing Vessels Refrigerated Transport Vessels and Supply Vessels. In: FAO Fisheries and Aquaculture Department [online]. Rome. Updated 12 February 2015. Available at: <http://www.fao.org/fishery/global-record/en>

Food and Drug Administration of the United States (FDA) (1906) Federal Meat Inspection Act. Available at: <http://www.fda.gov/RegulatoryInformation/Legislation/ucm148693.htm>

FDA (2009) Bioterrorism Act of 2002. Available at: <http://www.fda.gov/regulatoryinformation/legislation/ucm148797.htm>

FDA (2011) *Food Safety Modernization Act (FSMA): Sec 204 Enhancing Tracking and Tracing of Food and Recording*. Available at: <http://www.fda.gov/food/guidanceregulation/fsma/ucm247548.htm#SEC204>

FDA (2014) *Public Health Service Briefing Document: FY12-, FY13-CFSAN Sampling for Seafood Species Labeling in Imported and Wholesale Seafood*. Available at: <http://www.fda.gov/downloads/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/Seafood/UCM419983.pdf>

FDA (2016) *FDA Food Safety Modernization Act (FSMA)*. Available at: <http://www.fda.gov/food/guidanceregulation/fsma/default.htm>

FDA (2017a) *Draft Methodological Approach to Identifying High-Risk Foods under Section 204(d)(2) of the FSMA*. Available at:

<http://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm380210.htm>

FDA (2017b) Seafood HACCP. Website. Available at:

<http://www.fda.gov/food/guidanceregulation/haccp/ucm2006764.htm>

FDA (2017c) Frequently Asked Questions on FSMA. Website. Available at:

<http://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm247559.htm>

FishWise (2016a) *Social Responsibility in the Global Seafood Industry: Background and Resources*. White paper. Available at: <https://www.fishwise.org/wp-content/uploads/2016/12/Social-Responsibility-in-the-Global-Seafood-Industry-Dec-2016.pdf>

[f](https://www.fishwise.org/wp-content/uploads/2016/12/Social-Responsibility-in-the-Global-Seafood-Industry-Dec-2016.pdf)

FishWise (2016b) *Press Release: FishWise Partner Albertsons Expands Responsible Seafood Program - "Top 20 by 2022"*. Available at: <https://www.fishwise.org/2016/11/01/press-release-fishwise-partner-albertsons-expands-responsible-seafood-program-top-20-by-2022/>

Food Standards Australia New Zealand (FSANZ) (2017) Seafood Standards. Website. Available at:

<http://www.foodstandards.gov.au/code/primaryproduction/seafood/Pages/default.aspx>

Foulke, J.E. (1993) *Is something fishy going on? Intentional mislabeling of fish*. FDA Consumer.

Available at: <http://www.highbeam.com/doc/1G1-14397937.html>

Future of Fish (2016a) *T101 Videos: End-to-End Traceability is a Supply Chain Decision*. Available at:

<http://futureoffish.org/content/t101-videos-end-end-traceability-supply-chain-decision>

Future of Fish (2016b) *The Untapped Potential of Story to Sell Seafood*. Available at:

http://futureoffish.org/sites/default/files/docs/resources/Storied%20Fish%20Report_Aug2016.pdf

Future of Fish, FishWise, Global Food Traceability Center (2016) *Seafood Traceability Glossary: A guide to terms, technologies, and topics*. Available at:

http://futureoffish.org/sites/default/files/docs/resources/T101-Seafood%20Traceability%20Glossary%20WEB_0.pdf

Greenpeace (2014a) *Slavery and Labour Abuse in the Fishing Sector*. Available at:

<http://www.greenpeace.org/international/Global/international/briefings/oceans/2014/Slavery-and-Labour-Abuse-in-the-Fishing-Sector.pdf>

Greenpeace (2014b) *Supply Chained: Human rights abuses in the global tuna industry*. Available at:

<http://www.greenpeace.org/usa/wp-content/uploads/2015/11/Supply-chained.pdf?a1481f>

Hodal, K, C. Kelly, F. Lawrence (2014) *Revealed: Asian slave labor producing prawns for supermarkets in US, UK*. The Guardian. Available at: <https://www.theguardian.com/global-development/2014/jun/10/supermarket-prawns-thailand-produced-slave-labour>

International Transport Worker's Federation (ITF) (2016) Flags of Convenience Campaign. Website. Available at: <http://www.itfglobal.org/en/transport-sectors/seafarers/in-focus/flags-of-convenience-campaign/>

Lacey Act (2011) United States Department of Agriculture: Lacey Act. Available at: http://www.aphis.usda.gov/plant_health/lacey_act/

Logan, C., et al. (2008) *An impediment to consumer choice: Overfished species are sold as Pacific red snapper*. Biological Conservation. Volume 141, Issue 6, Pages 1591-1599. doi:10.1016/j.biocon.2008.04.007.

Long, T. (2016) *Vessel Identification: Ever Closer to a Foolproof System*. Pew Environment Group. Analysis, March 07, 2016. Available at: <http://www.pewtrusts.org/en/research-and-analysis/analysis/2016/03/03/vessel-identification-ever-closer-to-a-foolproof-system>

K&L Gates LLP (2012) *California Transparency in Supply Chains Act - First 90 Days*. JD Supra Law News. Available at: <http://www.jdsupra.com/legalnews/california-transparency-in-supply-chains-85821/>

Kailola, P. (2015) *Crew conditions on fishing vessels in the Pacific Islands region*. Discussion paper. Pacific Tuna Forum 2015.

Kappel, K., and Schröder, U. (2016) *Substitution of high-priced fish with low-priced species: Adulteration of common sole in German restaurants*. Food Control, 59, 478-486.

Magera A. and Beaton S. (2009) *Seafood Traceability in Canada: Traceability systems, certification, eco-labeling and standards for achieving sustainable seafood*. Available at: http://www.seachoice.org/wp-content/uploads/2011/09/Seafood_Traceability_in_Canada.pdf

Mao, G.F. (2014) *Plenty of trade, little traceability in Chinese seafood trade*. SeafoodSource. January 14, 2014. Available at: <http://www.seafoodsource.com/commentary/plenty-of-trade-little-traceability-in-chinese-seafood-trade>

Marine Stewardship Council (MSC) (2011) *Lack of evidence blocks MSC investigation into toothfish mislabelling claims*. Available at: <http://www.msc.org/where-to-buy/news/newsitem/update-lack-of-evidence-blocks-msc-investigation-into-toothfish-mislabelling-claims>

MSC (2016a) *Global Impact Report 2016*. Available at: <https://www.msc.org/documents/environmental-benefits/global-impacts/msc-global-impacts-report-2016>

MSC (2016b) *Tri Marine secures MSC certification for skipjack and yellowfin*. June 2, 2016. Available at: <https://www.msc.org/newsroom/news/tri-marine-secures-msc-certification-for-skipjack-and-yellowfin>

Marko, P., Nance, H., and Guynn, K. (2011) *Genetic detection of mislabeled fish from a certified sustainable fishery*. *Current Biology*. Vol. 21, Issue 16, pp. R621-R622
doi:10.1016/j.cub.2011.07.006.

Mason, M., et al. (2015) *Global Supermarkets selling shrimp peeled by slaves*. The Associated Press. Available at: <https://www.ap.org/explore/seafood-from-slaves/global-supermarkets-selling-shrimp-peeled-by-slaves.html>

McDowell, R., Mason, M., and Mendoza M. (2015) *AP investigation: Slaves may have caught the fish you bought*. Available at: <https://www.ap.org/explore/seafood-from-slaves/ap-investigation-slaves-may-have-caught-the-fish-you-bought.html>

MRAG Asia Pacific (2016) *Towards the quantification of illegal, unreported, and unregulated (IUU) fishing in the Pacific Islands region*. Available at: <http://www.m2cms.com.au/uploaded/5/ZN1981%20-%20MRAG%20AP%20FFA%20IUU%20Report.pdf>

NOAA and European Commission (2012) Joint statement from Maria Damanaki, European Union Commissioner for Maritime Affairs and Fisheries, and Jane Lubchenco, Ph.D., United States Under Secretary of Commerce for Oceans and Atmosphere. Available at: <http://www.noanews.noaa.gov/stories2012/05-30-12%20Lubchenco-Damanaki%20Statement-FINAL.pdf>

National Oceanic and Atmospheric Administration (NOAA) (2011) U.S., European Union to strengthen cooperation to combat illegal fishing. Website. Available at: http://www.noanews.noaa.gov/stories2011/20110907_iuufishing.html

NOAA (2015) United States continues global leadership to address illegal, unreported, and unregulated fishing. Website. Available at: <http://www.noanews.noaa.gov/stories2015/20150208-united-states-continues-global-leadership-to-address-illegal-unreported-and-unregulated-fishing.html>

NOAA Fisheries Office of International Affairs (NOAA FOIA) Website. Available at: <http://www.nmfs.noaa.gov/ia/> (accessed January 20, 2017)

NOAA Office of Law Enforcement (NOAA OLE) Website. Available at: <http://www.nmfs.noaa.gov/ole/> (accessed January 20, 2017)

NOAA Seafood Inspection Program (NOAA SIP) Website. Available at: <http://www.seafood.nmfs.noaa.gov/> (accessed January 20, 2017)

Oceana (2016) *Deceptive Dishes: Seafood Swaps Found Worldwide*. Available at: http://usa.oceana.org/sites/default/files/global_fraud_report_final_low-res.pdf

Oceana Europe (2015) *Too cheap to be true: Seafood fraud in Brussels*. Available at: http://eu.oceana.org/sites/default/files/421/oceana_factsheet_seafood_fraud_brussels_eng.pdf

Petersen, A. and Green, D. (n.d.) *Seafood Traceability: A Practical Guide for the U.S. Industry*. North Carolina: National Fisheries Institute, Inc. and North Carolina Sea Grant. Available at: <http://seafood.oregonstate.edu/.pdf%20Links/Seafood%20Traceability%20-%20A%20Practical%20Guide.pdf>

Pew Environment Group (Pew) (2017) Port State Measures Agreement ratification progress mapped by country. Website. Available at: <http://www.pewtrusts.org/en/multimedia/data-visualizations/2014/psma>

S.B. 657 (2010) California Transparency in Supply Chains Act of 2010. <https://www.dol.gov/ilab/child-forced-labor/California-Transparency-in-Supply-Chains-Act.htm>

Sea Delight (2016) Sea Delight's Seafood Traceability Policy. Website. Available at: <http://www.sea-delight.com/traceabilitypolicy>

Seafish (2015) *Focus on Ethical Issues in Seafood: China Profile*. Available at: http://www.seafish.org/media/publications/ChinaEthicsProfile_201509.pdf

Seafood Task Force (2017) About: The Seafood Task Force. Website. Available at: <http://www.seafoodtaskforce.global/about/current-members/>

Scott-Thomas, C. (2012) *New Canadian guidelines target single food inspection system*. Food Navigator USA. Available at: <http://www.foodnavigator-usa.com/Regulation/New-Canadian-guidelines-target-single-food-inspection-system>

Sea Pact (2016) *About*. Website. Available at: <http://www.seapact.org/about.html>

Stringer, C., Whittaker, D.H., and Simmons, G. (2016) *New Zealand's Turbulent Waters: The Use of Forced Labor in the Fishing Industry*. *Global Networks* 16.1: 3-24. Wiley Online Library. Web.

Sylwester, J.G. (2014) *Fishers of men: the neglected effects of environmental depletion on labor trafficking in the Thai fishing industry*. *Pac. Rim L. & Pol'y J.* 23 (2014): 423.

Tavernise, S. (2004) *3 Are Sentenced for Smuggling Chilean Sea Bass and Rock Lobster*. *The New York Times*. Available at: <http://www.nytimes.com/2004/05/29/nyregion/3-are-sentenced-for-smuggling-chilean-sea-bass-and-rock-lobster.html>

Tennyson, J.M., Winters, K.S., and Powell, K. (1997) *A fish by any other name: A report on species substitution*. Papers presented at the 22nd annual meeting of Seafood Science the Technology Society of the Americas, Biloxi, Mississippi.

Tri Marine Group (2017) Sustainability. Website. Available at: <http://www.trimarinegroup.com/activities/sustainability.html>

Uniform Code Council, Inc. (2003) *Global Trade Item Numbers Implementation Guide*. Available at: <http://www.barsnstripes.com/docs/GTIN.pdf>

United Nations (2013) *United Nations Convention on the Law of the Sea of 10 December 1982 (UNCLOS): Overview and full text*. Available at: <http://www.imo.org/en/About/Conventions/StatusOfConventions/Documents/Status%20-%202017.docx.pdf>

United Nations Office on Drugs and Crime (UN ODC) (2011) *Transnational Organized Crime in the Fishing Industry*. Available at: [http://www.unodc.org/documents/human-trafficking/Issue Paper - TOC in the Fishing Industry.pdf](http://www.unodc.org/documents/human-trafficking/Issue_Paper_-_TOC_in_the_Fishing_Industry.pdf)

Urbina, Ian (2015) *The Outlaw Ocean*. New York Times. Available at: http://www.nytimes.com/interactive/2015/07/24/world/the-outlaw-ocean.html?_r=0

Undercurrent News (2014) *Russia-Japan IUU agreement to take effect Dec. 10*. Available at: <https://www.undercurrentnews.com/2014/12/01/russia-japan-iuu-agreement-to-take-effect-dec-10/>.

United States Department of Agriculture (USDA) (2012) Agriculture Marketing Service, Country of Origin Labeling. Website. Available at: <https://www.ams.usda.gov/rules-regulations/cool>

United States Department of Agriculture (USDA) (2015) *China: China's Food Safety Law (2015)*. Available at: <https://www.fas.usda.gov/data/china-china-s-food-safety-law-2015>

Wegmans Food Markets (2015) *Accountability and transparency are keys to seafood sustainability*. Perishable News. Available at: <http://www.perishablenews.com/index.php?article=0046367http://>

Wietecha, O. (2015) *Norpac owner Kraft sees promise in electronic traceability pilot in Indonesia*. Undercurrent News. Available at: www.undercurrentnews.com/2015/10/07/norpac-owner-kraft-sees-promise-in-electronic-traceability-pilot-in-indonesia/



P.O. Box 233 | Santa Cruz CA 95061 | 1.831.427.1707 | www.fishwise.org