



# BASELINE ASSESSMENT OF EPO TUNA FISHERIES, USING THE FISHERIES PERFORMANCE INDICATORS

## FINAL REPORT

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## TABLE OF CONTENTS

|                                                                                                                                                                 |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 1. INTRODUCTION.....                                                                                                                                            | 4  |
| 2. BACKGROUND.....                                                                                                                                              | 6  |
| 2.1. GLOBAL TUNA FISHERIES .....                                                                                                                                | 6  |
| 2.2. TUNA FISHERIES IN THE EASTERN PACIFIC OCEAN .....                                                                                                          | 6  |
| 2.2.1.Tuna Fishery Regulations in The Eastern Pacific Ocean .....                                                                                               | 9  |
| 2.3. THE ECUADORIAN PURSE-SEINE TUNA FLEET IN THE EASTERN PACIFIC OCEAN .....                                                                                   | 10 |
| 2.4. THE MEXICAN PURSE-SEINE TUNA FLEET IN THE EASTERN PACIFIC OCEAN .....                                                                                      | 13 |
| 2.5. THE INDUSTRIAL LONGLINE FLEET IN THE EASTERN PACIFIC OCEAN...                                                                                              | 15 |
| 2.6. STOCK ASSESSMENT FOR THE THREE COMMERCIAL SPECIES OF TUNA IN THE EASTERN PACIFIC OCEAN.....                                                                | 18 |
| 2.6.1.Results of Stock Assessment for Bigeye Tuna .....                                                                                                         | 18 |
| 2.6.2.Results of Stock Assessment for Yellowfin Tuna.....                                                                                                       | 18 |
| 2.6.3.Results of Stock Assessment for Skipjack Tuna .....                                                                                                       | 19 |
| 3. BASELINE ASSESSMENT OF THE PURSE-SEINE TUNA FLEET IN THE EASTERN PACIFIC OCEAN USING THE FISHERY PERFORMANCE INDICATORS (FPI) FOR THE TUNA FISHERIES .....   | 20 |
| 3.1. METHODOLOGY AND DATA.....                                                                                                                                  | 20 |
| 3.1.1.Fishery Performance Indicators – General Approach .....                                                                                                   | 20 |
| 3.1.2.Data.....                                                                                                                                                 | 24 |
| 3.2. RESULTS.....                                                                                                                                               | 25 |
| 3.2.1.Stock Performance Indicators (Output Indicators) for the BET, YFT and SJT Fishery in the Eastern Pacific Ocean.....                                       | 26 |
| 3.2.2.Input and Output Indicators for the Ecuadorian Purse Seine Fleet - Eastern Pacific Ocean - Case Study for the Purse Seine Fishery that Sets on FADs ..... | 28 |
| 3.2.2.1. <i>Output Indicators</i> .....                                                                                                                         | 28 |
| <i>Harvest Sector Performance Component</i> .....                                                                                                               | 28 |
| <i>Post-Harvest Sector Performance Component</i> .....                                                                                                          | 29 |
| 3.2.2.2. <i>Input Indicators</i> .....                                                                                                                          | 31 |
| 3.2.3.Input and Output Indicators for the Mexican Purse Seine Fleet - Eastern Pacific Ocean - Case Study for the Purse Seine Fishery that Sets on dolphins..... | 36 |
| 3.2.3.1. <i>Output Indicators</i> .....                                                                                                                         | 36 |
| <i>Harvest Sector Performance Component</i> .....                                                                                                               | 36 |
| <i>Post-Harvest Sector Performance Indicator</i> .....                                                                                                          | 38 |

|          |                                                                                                                                                                                                 |    |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 3.2.3.2. | <i>Input Indicators</i> .....                                                                                                                                                                   | 40 |
| 3.2.4.   | Input and Output Indicators for the Asian Industrial Longline Fleet - Eastern Pacific Ocean - Case Study for the Industrial Longline Fishery that Targets Adult Bigeye and Yellowfin Tunas..... | 44 |
| 3.2.4.1. | <i>Output Indicators</i> .....                                                                                                                                                                  | 45 |
|          | <i>Harvest Sector Performance Indicator</i> .....                                                                                                                                               | 45 |
|          | <i>Post-Harvest Sector Performance Indicator</i> .....                                                                                                                                          | 46 |
| 3.2.4.2. | <i>Input Indicators</i> .....                                                                                                                                                                   | 47 |
| 4.       | CONCLUSIONS .....                                                                                                                                                                               | 50 |
| 5.       | REFERENCES .....                                                                                                                                                                                | 54 |

## TABLE OF CONTENTS

### ANNEXES

|                                                                                                   |    |
|---------------------------------------------------------------------------------------------------|----|
| A1: FISHERY PERFORMANCE INDICATORS (FPI) FOR THE PURSE SEINE FLEET FROM COLOMBIA AND PANAMA ..... | 57 |
| A1.1. Input and Output Indicators for the Colombian Purse Seine Fleet .....                       | 57 |
| <i>A1.1.1. Output Indicators</i> .....                                                            | 57 |
| <i>A1.1.2. Input Indicators</i> .....                                                             | 59 |
| A1.2. Input and Output Indicators for the Panamanian Purse Seine Fleet .....                      | 63 |
| <i>A1.2.1. Output Indicators</i> .....                                                            | 63 |
| <i>A1.2.2. Input Indicators</i> .....                                                             | 64 |
| A2: FPI SUPPLEMENT - ACCESS PAYMENTS .....                                                        | 66 |
| A2.1. Output Indicators .....                                                                     | 67 |
| <i>A2.1.1. Output Indicator 1: Payment</i> .....                                                  | 67 |
| <i>A2.1.2. Output Indicator 2: Lessor State Industry</i> .....                                    | 69 |
| <i>A2.1.3. Output Indicator 3: Domestic Fleets</i> .....                                          | 70 |
| A2.2. Input/Enabling Conditions Indicators .....                                                  | 70 |
| <i>A2.2.1. Input Indicator 1: Agreement Scope</i> .....                                           | 70 |
| <i>A2.2.2. Input Indicator 2: Lessor Governance</i> .....                                         | 71 |
| <i>A2.2.3. Input Indicator 3: Lessee Governance</i> .....                                         | 71 |
| <i>A2.2.4. Input Indicator 4: Management and Enforcement</i> .....                                | 72 |
| <i>A2.2.5. Input Indicator 4: Rights Properties of Leased Access</i> .....                        | 73 |
| A2.3. Recommendation – Additional Dimension or Indicator .....                                    | 74 |
| A3: SUPPORTING MATERIAL - FPI SCORES .....                                                        | 74 |

## 1. INTRODUCTION<sup>1</sup>

The status and management of large pelagic fish populations worldwide is a cause of concern (Pauly et al., 1998; Jackson et al., 2001; Baum et al., 2003; Myers and Worm, 2003). Tunas are among the most vulnerable species, since they range across the jurisdictions of a large variety of countries, and much of their stock is found in the high seas. In this sense, the main purpose of this study is to carry out a baseline assessment of the key industrial tuna fisheries operating in the Eastern Pacific Ocean (EPO), using the Fishery Performance Indicators (FPI) methodology, developed by the World Bank (Anderson et al., 2015).

The FPI is a rapid assessment instrument designed: a) to capture the extent to which fishery resources contribute to the wealth of the people and communities that depend on them, and b) to list factors supporting such generation of wealth (Anderson et. al. 2015). This methodology includes 68 measures that allow practitioners to assess wealth accumulation on 11 dimensions of the stock, harvest industry performance, and post-harvest industry performance, and 54 measures of enabling factors –including management and governance– to associate with variations in outcomes. Each measure is scored –accurately, but with low precision– on a one-to-five scale, using data where possible, but primarily relying on non-quantitative factors that can be scored by experts in any fishery or fishery sector. This feature makes the FPI methodology particularly well suited to applications in data-poor countries or industry sectors (Anderson et. al. 2015).

It is important to emphasize that there are limitations and challenges to the use of the FPI, mostly because in some cases use expert assessments as a proxy for data. Therefore, this is a tool that renounces precision in exchange for promptness and viability to conduct an assessment for all types of fisheries, most of which suffer from having a poor or non-existent data (Poteete & Ostrom, 2008)<sup>2</sup>. There are also problems with the way that the FPI was constructed. To be precise,

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<sup>1</sup> I appreciate the cooperation of Viviana Oña Egas, research assistant and student at Universidad San Francisco de Quito, in the elaboration of this document, in terms of editing and final preparation of the text.

<sup>2</sup> It is necessary to clarify that the FPI scoring system integrates information from experts when data is unavailable (i.e. data poor), but this does not mean that the methodology allows to making stuff up when nobody knows anything about a specific indicator.

it was designed as a one-size-fits-all methodology, but there are some specificities of some fisheries industries that the methodology cannot fully capture. This issue makes it slightly problematic to perfectly adapt this methodology to industrial transboundary fisheries, such as the industrial tuna fisheries in the EPO.

Despite these problems and limitations, the rapid assessment derived from the FPI can provide a clear insight about the ecological, social, and economic status of the fisheries' management systems. In addition, all this information can be obtained at a low cost. For these reasons, the FPI is very useful, and its continuous use on different frameworks makes it possible to correct problems and weaknesses.

In this study, we will analyze the FPI for the industrial scale fisheries in the Eastern Pacific Ocean, with a focus on: 1) the purse-seine fishery that operates using fish aggregating devices (FADs), taking as an example the Ecuadorian fleet; 2) the purse-seine fishery that sets on dolphins, using as a case study the Mexican fleet; and 3) the industrial longline harvest sector that targets adult bigeye and yellowfin tuna, taking as reference the Asian industrial longline fleet that operates in the EPO. We will also use in this report a sub-classification based on the three commercial tuna species that are captured in the EPO (i.e. Bigeye tuna, Skipjack tuna and Yellowfin tuna). This sub-classification does not imply that they are three different fisheries, but we include that division because the final objective is to design specific regulations for each of these three-tuna species.

At the end, the objective of this document is to provide a set of recommendations of the main factors that we think that should be strengthened to improve the economic and social aspects of the tuna fishery in the EPO, as well as the biological health of the main commercial tuna species caught in the area.

In the Annexes of this document, an analysis of two additional purse-seine fleets (i.e. Colombia and Panama) that supplies the Ecuadorian processor sector is provided along with the results of a Supplement to the FPI to address access arrangements. This will extend and deepen the evaluation of the industrial tuna fishery sector operating in the EPO.

## 2. BACKGROUND

### 2.1. GLOBAL TUNA FISHERIES

In 2014, the global tuna catch reached 5.9 million tonnes, which represents a 5% increase compared to 2013. Ranked by species, in 2014, skipjack composed most the catch (52%), followed by yellowfin (25%), bigeye (7%), albacore (4%), and other tuna species (12%). In terms of fishing gear, 64% of the catch was made by purse seining, followed by longline (12%), pole-and-line (9%), gillnets (4%) and miscellaneous gears (11%). Regarding each country's participation in the global total catch, two countries in the EPO, specifically Ecuador (i.e. 7th place) and Mexico (11th place), are among the main tuna producers in the world during the period 2000-2014 (Table 1).

**Table 1. Ranking of countries by tuna production**

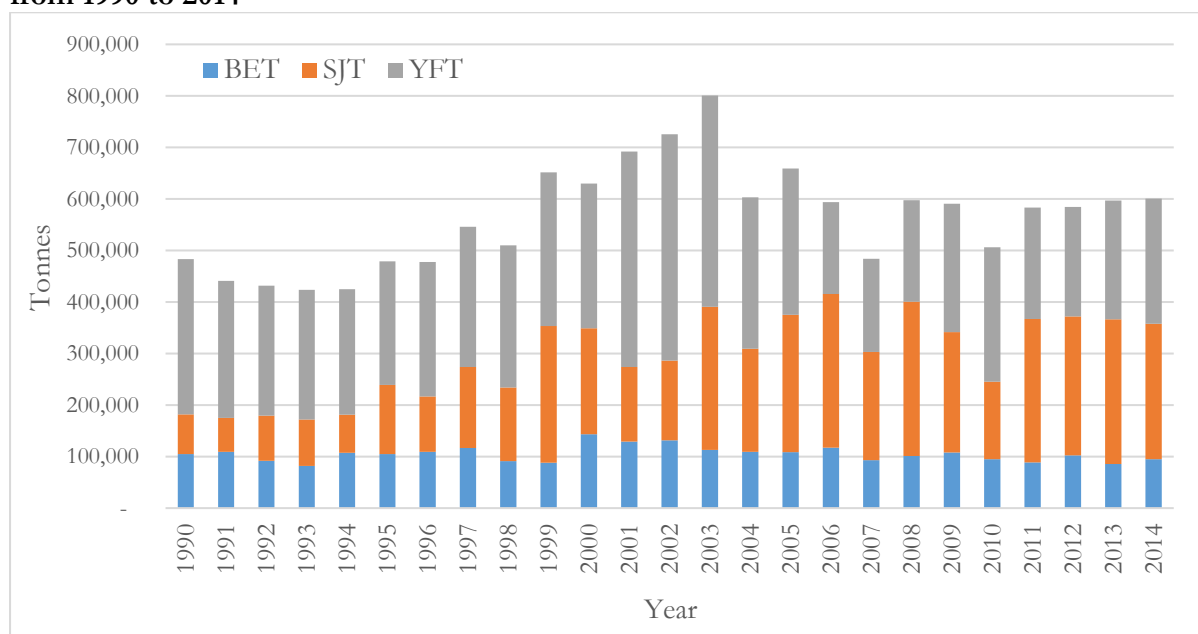
| Rank | Country                  | Catch  |
|------|--------------------------|--------|
| 1    | Indonesia                | 13.72% |
| 2    | Japan                    | 10.41% |
| 3    | Philippines              | 9.33%  |
| 4    | Taiwan                   | 7.83%  |
| 5    | Spain                    | 5.61%  |
| 6    | South Korea              | 5.33%  |
| 7    | Ecuador                  | 4.64%  |
| 8    | Papua New Guinea         | 3.74%  |
| 9    | United States of America | 3.45%  |
| 10   | France                   | 2.67%  |
| 11   | Mexico                   | 2.66%  |
|      | Other countries          | 30.62% |

### 2.2. TUNA FISHERIES IN THE EASTERN PACIFIC OCEAN

Approximately 12% of the global production of tuna comes from the Eastern Pacific Ocean (EPO). Total catches of Bigeye Tuna (BET), Yellowfin Tuna (YFT) and Skipjack Tuna (SJT) in 2014 in the EPO summed up to approximately 600,391 tonnes, which represents a 0.57% increase in comparison to the catch of 2014, and a 3.54% increase in the average catch of the ten previous years (i.e. 2004-2013). As shown in Figure 1, the total catch has presented a negative trend since

2003 (year in which the catch of these species achieved a record level of 800,933 tonnes), reaching its minimum in 2010 (i.e. 483,660 tonnes). However, since 2011 a slow recovery of the catch is observed, which reached its peak in 2014 (though it is still 25% lower than the maximum catch recorded in 2003). Regarding the composition of the catch, according to the IATTC data, during the last five years (i.e. 2010-2014), approximately 43% of the total catch in the EPO was of SJT, while approximately 41% and 16% of the catch was of YFT and BET, respectively.

**Figure 1. Total Catch of Yellowfin, Bigeye and Skipjack Tuna in the Eastern Pacific Ocean from 1990 to 2014**

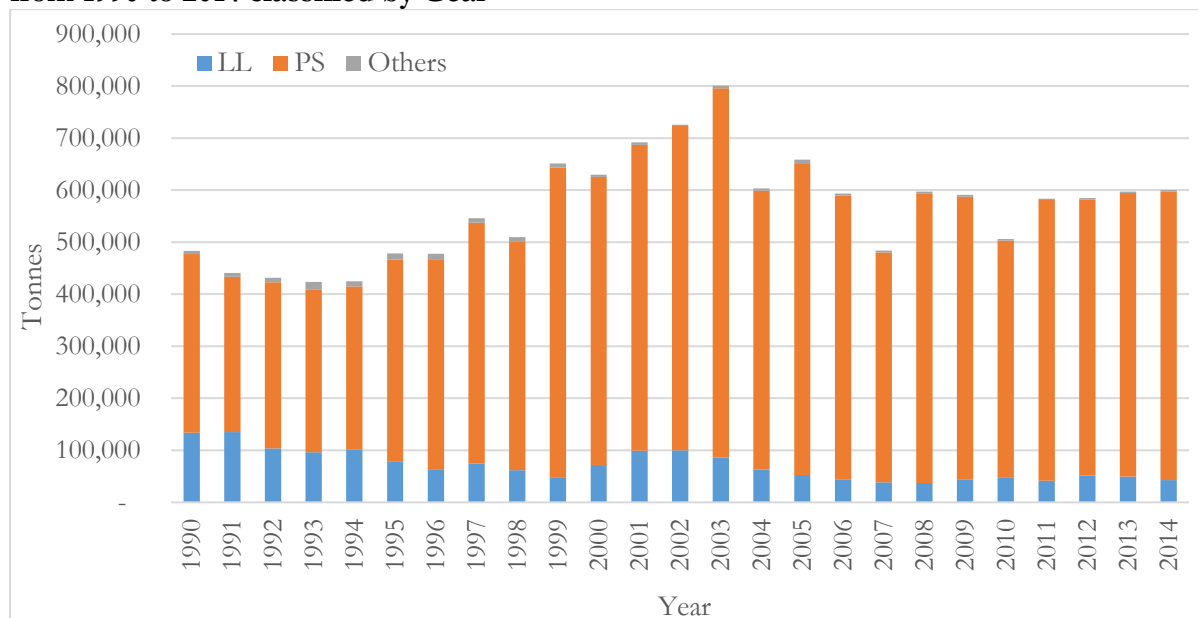


Source: IATTC

In the EPO, during the last five years (i.e. 2010-2014), approximately 91.4% of the catch was taken by purse-seine (PS) vessels, 8.1% was taken by long-line (LL) vessels, and the rest (i.e. 0.5%) corresponded to other types of vessels (Figure 2). PS vessels catch the three commercial tuna species in the EPO by using three different types of sets: dolphin (DEL), unassociated (NOA) and floating-object (OBJ). In the last five years (i.e. 2010-2014), PS vessels caught 51% of the tuna using OBJ sets, 30% using DEL sets, and the remaining 19% using NOA sets. It is important to emphasize that for each of the three commercial tuna species, the prevalence of the type of set is different. Thus, OBJ is the most important type of set for both BET (i.e. 98% of the total catch)

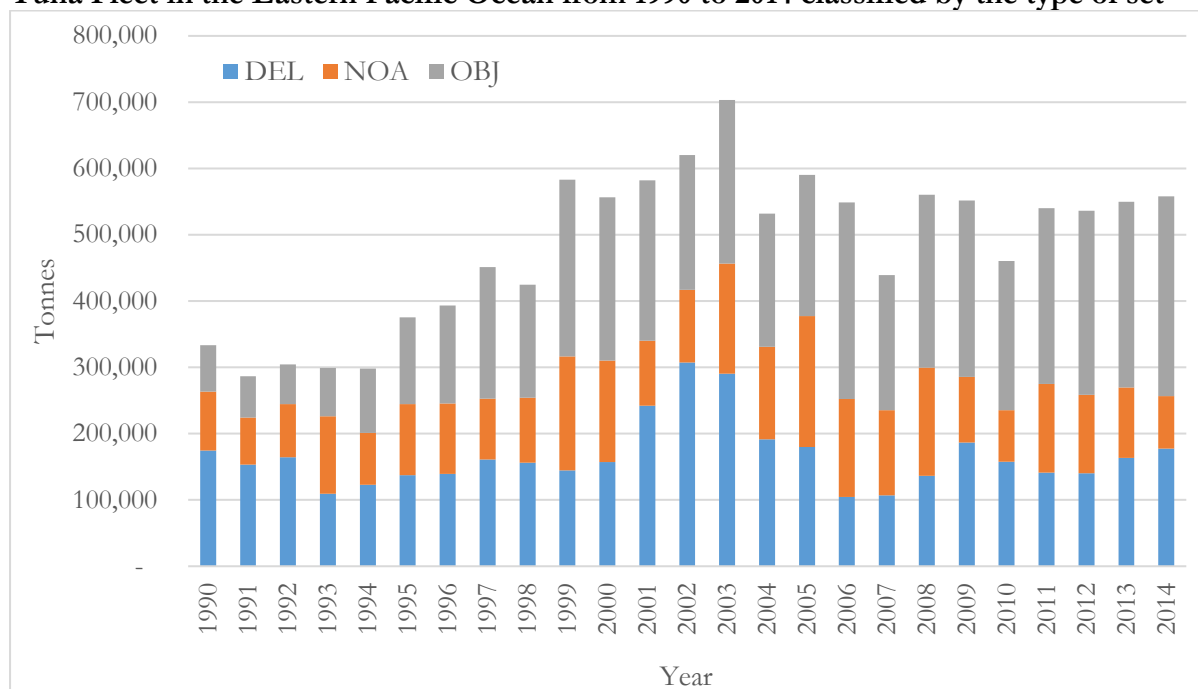
and SJT (70% of the total catch). On the other hand, DEL set is the most important for the catch of YFT (69% of the total catch).

**Figure 2. Total Catch of Yellowfin, Bigeye and Skipjack Tuna in the Eastern Pacific Ocean from 1990 to 2014 classified by Gear**



Source: IATTC

**Figure 3. Total Catch of Yellowfin, Bigeye and Skipjack Tuna by the IATTC's Purse Seine Tuna Fleet in the Eastern Pacific Ocean from 1990 to 2014 classified by the type of set**



Source: IATTC

### 2.2.1. Tuna Fishery Regulations in The Eastern Pacific Ocean

The management and conservation of the tuna fishery has required regional cooperation. In order to protect tuna worldwide, Regional Fishery Management Organizations (RFMOs) –such as the Inter-American Tropical Tuna Commission (IATTC)<sup>3</sup> in the EPO– are responsible for coordinating efforts of their member states. Hence, since 2004, the IATTC has implemented measures to limit purse-seine fishing efforts of the three-commercial species in the EPO: Bigeye tuna (BET), Yellowfin tuna (YFT) and Skipjack tuna (SJT). Consequently, purse-seine fisheries are regulated by closure policies and spatial fishing prohibitions, specifically:

1. Closure of 62 days. All class 5 and class 6 purse-seine vessels must stop fishing in the EPO for a period of 62 days. Members and cooperating non-members (CPC) of the IATTC decide which of the following two closure periods to observe: from July 29th to September 28th, or from November 18th to January 18th. Class 4 purse-seine vessels are able to make only one 30 days fishing trip during the specified closure periods, provided that any such vessel carries an observer from the On-Board Observer Program of the Agreement on the International Dolphin Conservation Program (AIDCP).
2. Prohibition of fishing activity by purse seiners in the area located between 96° W and 110° W, and 4° N and 3° S, area known as “El Corralito”, from 00:00 hours on September 29th to 24:00 on October 29th.
3. Purse-seine vessels of IATTC capacity classes 1-3 (182 metric tons carrying capacity or less), longline vessels less than 24 meters’ length, as well as pole-and-line, troll, and sport-fishing vessels are not subject to these measures.

In addition, the IATTC has also imposed limits on the total catches of BET, to longline vessels (i.e. longlines with overall length larger than 24 meters) from China, Japan, Korea and

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<sup>3</sup> The members of the IATTC are Belize, European Union, Nicaragua, Canada, France, Panama, China, Guatemala, Peru, Colombia, Japan, Chinese Taipei, Costa Rica, Kiribati, United States, Ecuador, Korea, Vanuatu, El Salvador, Mexico, and Venezuela. Bolivia, Honduras, Indonesia and Cook Islands are Cooperating Non-Members.

Chinese Taipei. Specifically, annual catches of BET by this fleet should not exceed the following levels:

| <b>Metric Tons</b> | <b>2014-2016</b> |
|--------------------|------------------|
| China              | 2,507            |
| Japan              | 32,372           |
| Korea              | 11,947           |
| Chinese Taipei     | 7,555            |

However, all of these measures have not been completely effective. Therefore, the use of complementary management options, along with the established capacity limits and seasonal closures of the tuna fishery in the EPO, has been unsuccessfully explored since 2006.

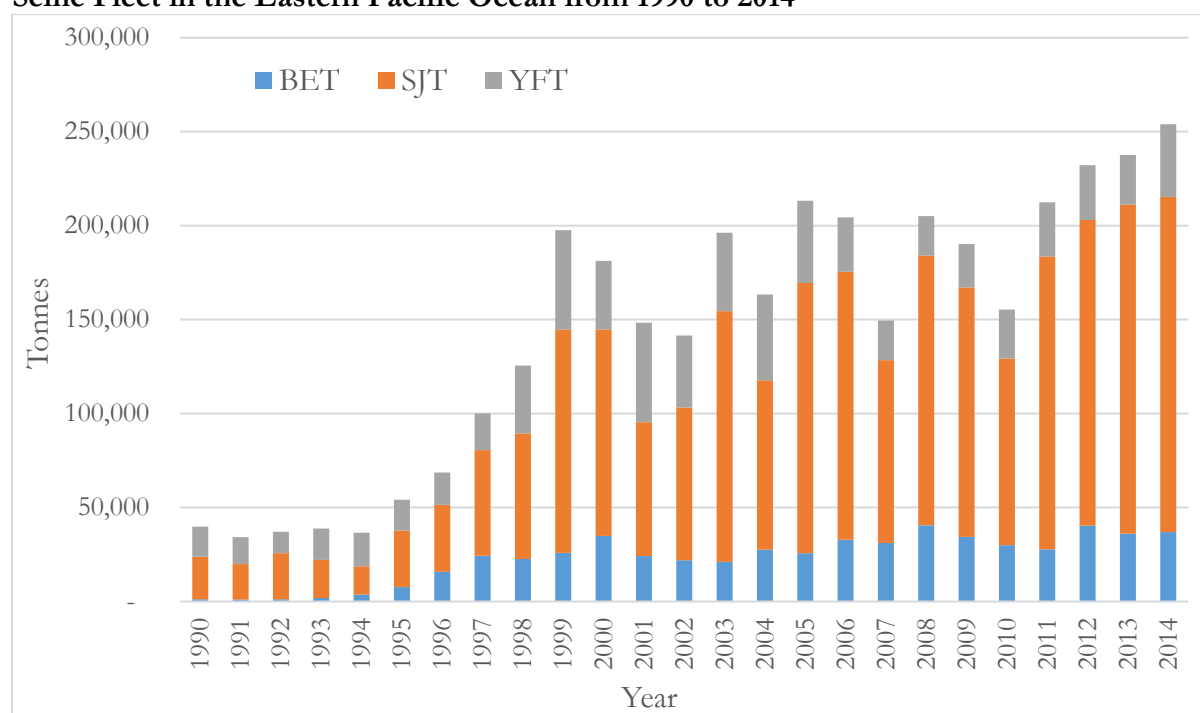
### **2.3. THE ECUADORIAN PURSE-SEINE TUNA FLEET IN THE EASTERN PACIFIC OCEAN**

The Ecuadorian PS fleet is composed of 115 vessels. This fleet is considered as the most productive in the EPO. Its production level is approximately 42% of the total amount of tuna caught in the EPO during 2014. On the other hand, the total catch of the Ecuadorian PS fleet represents approximately 46% of the catch of all purse-seiners that operate in the EPO. In 2014, total tuna catches of the Ecuadorian PS fleet in the EPO was approximately 253,941 tonnes. This represents a 6.85% increase over the catch of 2013, and a 29.32% increase in the average catch of the ten previous years (i.e. 2004-2013).

As observed in Figure 4, the total catch of the Ecuadorian PS fleet showed a cyclical behavior from 1999 to 2010. Then, since 2011, this fleet's catch has presented a positive trend, reaching its historical maximum in 2014. There is no sign of reversion in the trend.

On the other hand, most Ecuadorian PS fleet catch for 2014 was composed of SJT (70.2%), while BET and YFT represented 14.6% and 15.2%, respectively. This composition has remained stable throughout the last decade (i.e. in average, 69.3% SJT, 16.6% BET and 14.1% YFT).

**Figure 4. Total Catch of Yellowfin, Bigeye and Skipjack Tuna by the Ecuadorian Purse-Seine Fleet in the Eastern Pacific Ocean from 1990 to 2014**



**Source:** IATTC

In addition, even though the total catch of the Ecuadorian PS fleet, as well as its share of the total catch in the EPO, has been increasing, the performance by species is very dissimilar. In the case of the BET fishery, the average annual catch of the Ecuadorian PS fleet has increased in 28.15%, from the period 2000-2007 to the period 2008-2014. Specifically, the annual average catch has increased from 27,437 tonnes during the period 2000-2007 to 35,161 tonnes during the period 2008-2014. This translates into an increase in the participation of the Ecuadorian PS fleet on the total catch of BET in the EPO, from an annual average of 24% during the period 2000-2007 to an annual average of 36% during the period 2008-2014. In both periods, Ecuador has been the most important PS fleet of the BET fishery in the EPO. It has maintained an average proportion of 29.61% of the total catch of BET in the EPO during the period 2000-2014. It is essential to highlight that most of the Ecuadorian fleet's BET catch came from FADs (approximately more than 90% of the total catch of BET during 2008-2012), which leads us to infer that any attempt to control those devices can be a way to improve the health of this species.

In the case of the YFT fishery, the Ecuadorian catch has decreased from an average of 38,610 tonnes per year during the period 2000-2007, to an average of 27,622 tonnes during the period 2008-2014. That represents a contraction of approximately 28.45% in the average annual catch of YFT between both periods. Despite this shrinkage, Ecuador has been able to prevail as the third-most important purse-seine fleet in the YFT fishery in the EPO, with an average proportion of 12.53% of the total catch during the period 2000-2014. The two most important are the Mexican and Venezuelan PS fleets, with an average proportion of 39% and 16% respectively during the same period.

Finally, in the case of the SJT fishery, the Ecuadorian catch has increased from an average of 108,698 tonnes per year during the period 2000-2007, to an average of 149,653 tonnes during the period 2008-2014. That represents an increment of approximately 37.67% in the average annual catch of YFT between both periods. As in the case of the BET, Ecuador is the most important PS fleet of the SJT fishery in the EPO, with an average proportion of 54.24% of the total catch during the period 2000-2014.

Thus, it can be concluded that the Ecuadorian PS fleet is an important participant in the EPO, as well as in the world. For instance, Ecuador is the 7th biggest producer of tuna (YFT, BET and SJT) in the world. Specifically, Ecuador holds the 11th, 7th and 4th place for the catches of YFT, SJT and BET, respectively, during the period 2000 to 2014. Therefore, Ecuador is a very important participant in the world's tuna fishery, and any attempt to manage the Ecuadorian fleet effort would be beneficial not only for the EPO region, but for the world as well.

It is necessary to emphasize that an important characteristic of the fishing activity of the Ecuadorian PS fleet is the proportion of catch that comes from FADs. For instance, during the period 2008-2012, the catches on FADs were 53% for SJT, 60% for YFT and 90% for BET. Therefore, it can be argued that the catch of the three species by the Ecuadorian fleet is highly dependent on FADs. During the period from 2000 to 2007, the proportion of catch that came

from FADs were 44% for SJT, 30% for YFT and 79% for BET. These results implied that this fleet's dependence on FADs has grown in the last years.

## **2.4. THE MEXICAN PURSE-SEINE TUNA FLEET IN THE EASTERN PACIFIC OCEAN**

The Mexican PS fleet is composed of 49 vessels. This fleet's total catch constitutes approximately 22% of the total amount of tuna that was caught in the EPO during 2014. On the other hand, the total catch of the Mexican PS fleet represents approximately 23% of the total catch of all the purse-seiners that operate in the EPO. In 2014, total tuna catches of the Mexican PS fleet in the EPO were approximately 130,631 tonnes. This represents a 0.35% decrease compared to the catch of 2013, but a 19.66% increase in the average catch of the ten previous years (i.e. 2004-2013).

As observed in Figure 5, the Mexican PS fleet's total catch showed a cyclical behavior from 1990 to 2003. Then, it contracted from 2004 to 2007, and it began to recover slowly, since 2008 to 2014.

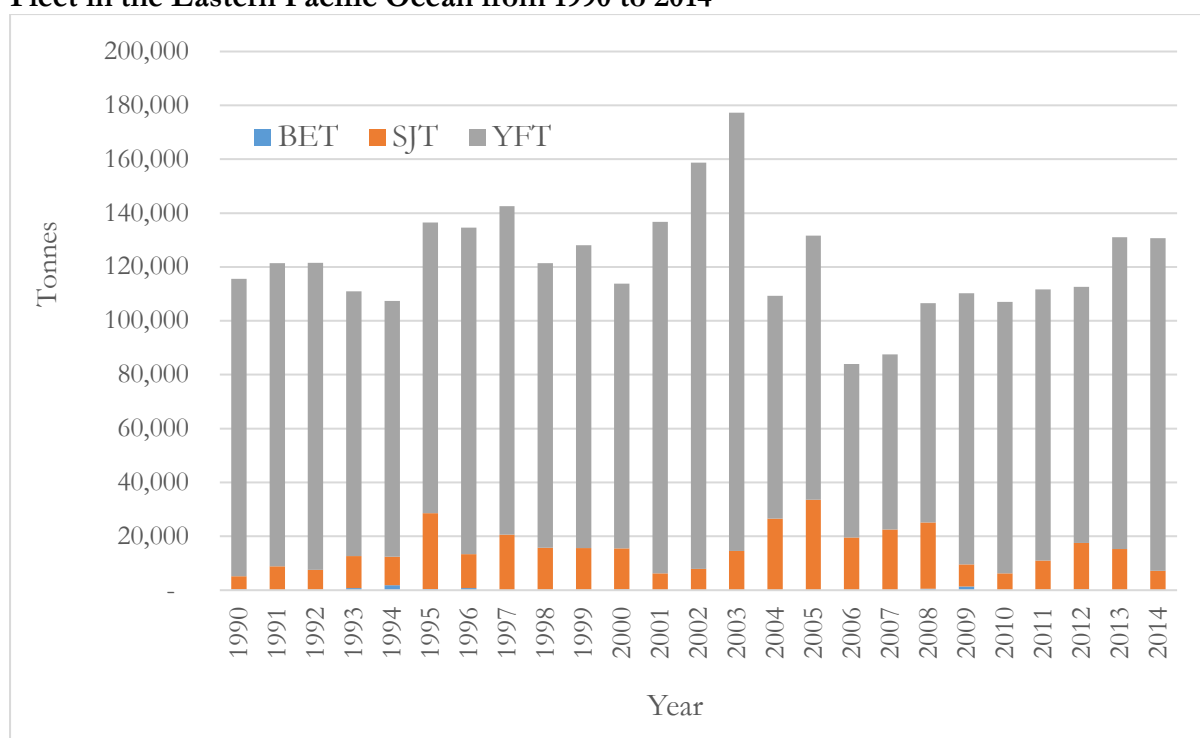
The composition of the catch of the Mexican PS fleet for 2014 was as follows: 94.45% YFT, 5.54% SJT and 0.01% BET. During the last decade, this composition has fluctuated, but has been, in average, of 84.3% YFT, 15.4% SJT and 0.3% BET.

The Mexican fleet's performance by species is homogenous, and the catch levels of the two most important species, YFT and SJT<sup>4</sup>, has decreased. In the case of the SJT fishery, the Mexican catch has decreased from an average of 18,201 tonnes per year during the period 2000-2007, to an average of 12,797 tonnes during the period 2008-2014. That represents a reduction of approximately 29.69% in the average annual catch of SJT between both periods.

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<sup>4</sup> For the Mexican PS fleet, we will not analyze the BET fishery since it is marginal (less than 0.5% of the total catch) and its total catch level ranged from 6 tonnes (in 2004) to 1,422 tonnes in (2009), with an average of less than 220 tonnes in the last decade.

**Figure 5. Total Catch of Yellowfin, Bigeye and Skipjack Tuna by the Mexican Purse-Seine Fleet in the Eastern Pacific Ocean from 1990 to 2014**



Source: IATTC

On the other hand, in the case of the YFT fishery, the Mexican catch has decreased from an average of 106,604 tonnes per year during the period 2000-2007, to an average of 102,526 tonnes during the period 2008-2014. That represents a contraction of approximately 3.83% in the average annual catch of YFT between both periods. Despite this contraction, Mexico has been able to remain as the most important purse-seine fleet in the YFT fishery in the EPO, with an average proportion of 39.20% of the total catch during the period 2000-2014, and a maximum of 51% of the total catch of YFT in the EPO in 2014.

To conclude, the Mexican PS fleet is not only a major participant in the EPO, but also an important participant in the world. For instance, Mexico has the 10<sup>th</sup> biggest total catch of YFT, BET and SJT in the world. Specifically, in the case of YFT, it is ranked third in the world. Something that is necessary to indicate is that most of the sets (between 80 and 95%) of the Mexican PS fleet are on dolphins. This has caused many legal and trading problems to this country, among which we highlight the USA embargo on Mexican tuna caught over dolphins.

## 2.5. THE INDUSTRIAL LONGLINE FLEET IN THE EASTERN PACIFIC OCEAN

The total catch of the industrial longline (LL) fleet represents approximately 7.1% of the total amount of tuna that was caught in the EPO during 2014. This share has remained stable during the last decade, with an average of 7.8% of the total tuna caught in the EPO during the period 2004-2014.

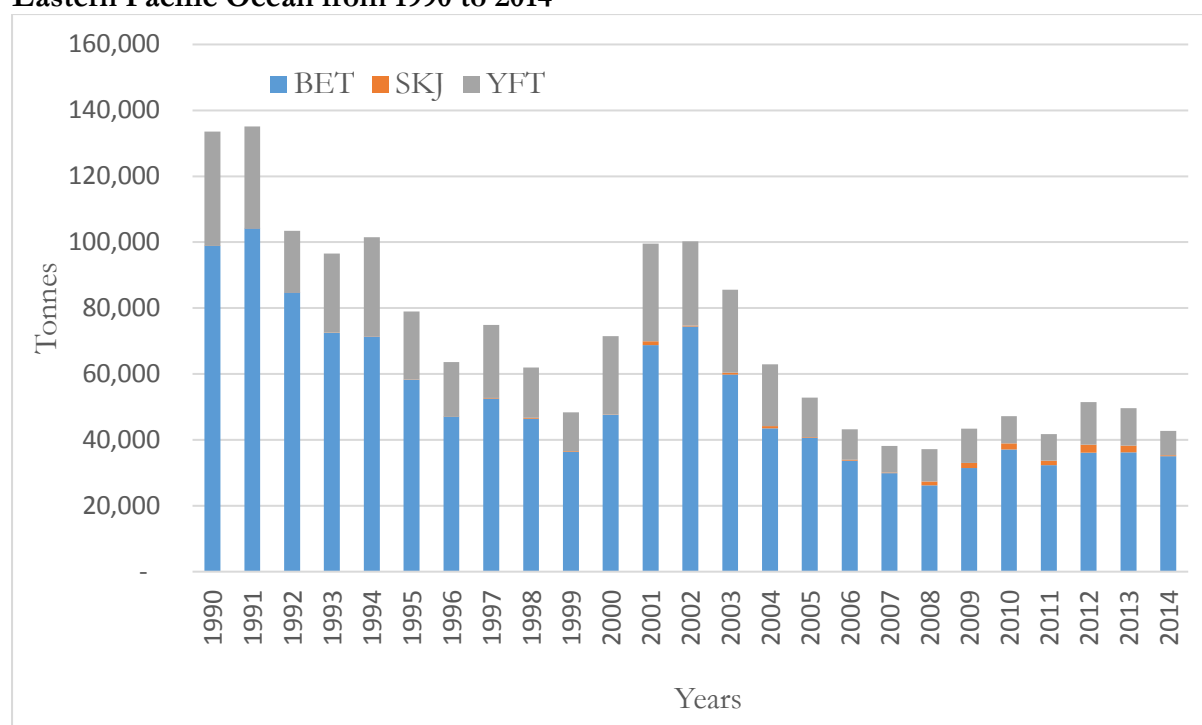
In 2014, total tuna catches of the LL fleet in the EPO were approximately 42,773 tonnes, which represents a 13.84% decrease compared to the catch of 2013 and a 9.43% decrease in the average catch of the ten previous years (i.e. 2004-2013). As shown in Figure 6, the total catch of the LL fleet has fallen from its maximum in 2003, and has not been able to recover since then.

Most of the LL fleet catches for 2014 was composed of BET (82.03%), followed by YFT (17.42%) and SJT (0.55%). In the last decade, this composition has fluctuated, but on average, it has been of 75.71% BET, 21.81% YFT and 2.48% SJT.

Another important characteristic of the LL fleet is that it is comprised of 1,288 vessels. The majority of those LL vessels (i.e. 73.1%) come from Asia; the rest come from the European Union (i.e. 11.8%), the Americas (i.e. 11.6%) and from Vanuatu and Kiribati (3.5%). The Asian fleet is not only the most important in the number of vessels, but also in terms of catch. In 2014, 88.7% of the total LL fleet's catch was caught by Asian vessels, and during the last decade, this percentage has averaged approximately 83.9% (Figure 7).

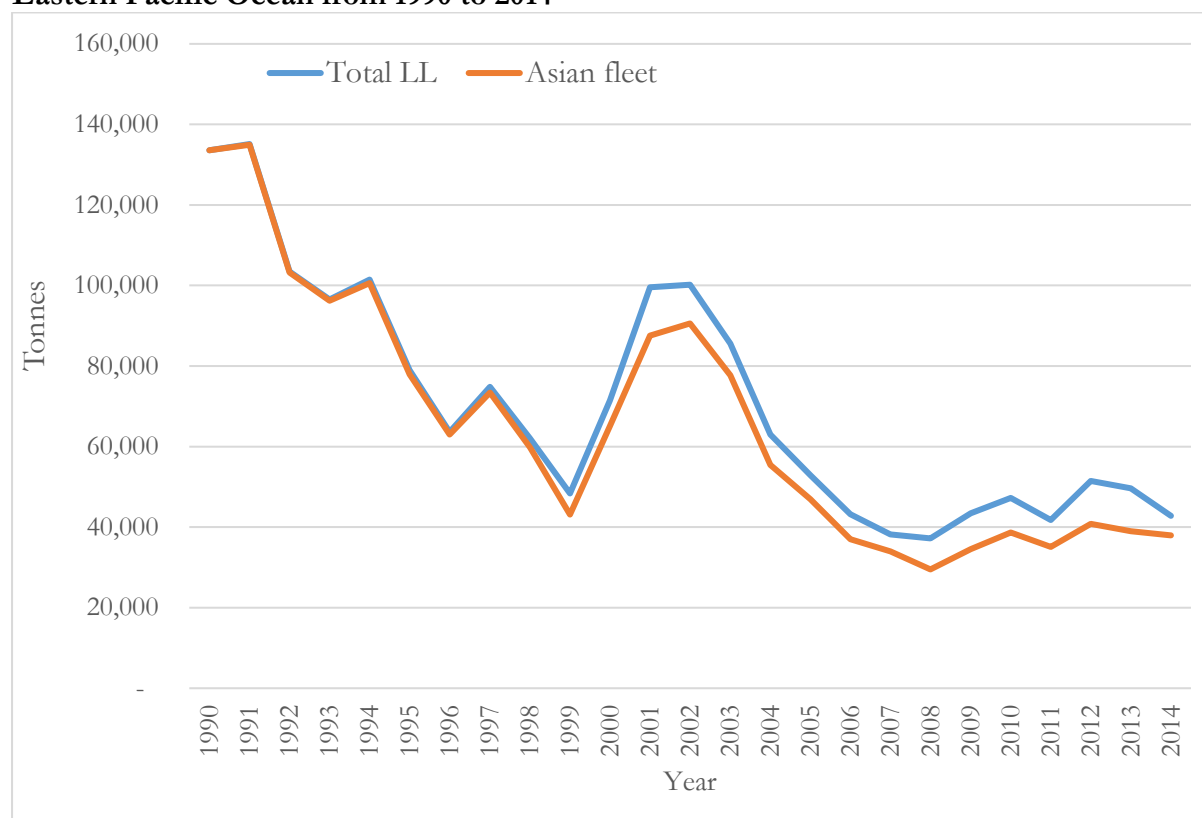
Given the high concentration of the effort in two species (i.e. BET and YFT), and given the high importance of the Asian (i.e. Japan, Korea, China and Chinese Taipei) LL fleet, we will focus the following analysis only on the performance of the Asian fleet, and the BET and YFT fishery.

**Figure 6. Total Catch of Yellowfin, Bigeye and Skipjack Tuna by the Longline Fleet in the Eastern Pacific Ocean from 1990 to 2014**



Source: IATTC

**Figure 7. Total Catch of Yellowfin, Bigeye and Skipjack Tuna by the Longline Fleet in the Eastern Pacific Ocean from 1990 to 2014**



Source: IATTC

The Asian LL fleet's performance by species is homogenous, but catch levels of both BET and YFT have decreased. In the case of the BET fishery, the catch of the Asian LL fleet has decreased from an average of 46,800 tonnes per year during the period 2000-2007, to an average of 30,104 tonnes per year during the period 2008-2014. This represents a reduction of approximately 35.67% in the average annual catch of BET between both periods.

On the other hand, in the case of the YFT fishery, the catch of the Asian LL fleet has decreased from an average of 14,826 tonnes per year during the period 2000-2007, to an average of 6,317 tonnes per year during the period 2008-2014. This represents a contraction of approximately 57.39% in the average annual catch of YFT between both periods.

It is important to recall that since 2011, the IATTC has imposed limits on the BET catches to Asian longline vessels (i.e. China, Japan, Korea and Chinese Taipei). This fleet's total BET annual catches should not exceed 54,381 tonnes per year. Specifically, the limits are 2,507 tonnes for China, 32,372 tonnes for Japan, 11,947 for Korea and 7,555 tonnes for Chinese Taipei. Hence, since 2011 the Asian fleet has not reached the total established limit by approximately 22,766 tonnes per year; in other words, their total catch is 0.58 of the total limit.

For the fleet of individual countries, the trend was not the same. For instance, in the case of the Japanese, Korean and Chinese Taipei LL fleet, their catches were 0.51 of their limits. On the other hand, the Chinese LL fleet's catch since 2011 has been, on average, 2.02 times the established limit. This was possible because the Chinese fleet was allowed to use a portion of the Japanese fleet's catch limit, through a temporary transfer agreement. For that reason, even though China is catching more BET than what was established by its catch limit, this is compensated by the small catch of the other Asian countries (specially Japan). Therefore, the Asian LL fleet catch is within the limits established by the IATTC through its conservation resolutions (i.e. C-11-01 and C-13-01).

## **2.6. STOCK ASSESSMENT FOR THE THREE COMMERCIAL SPECIES OF TUNA IN THE EASTERN PACIFIC OCEAN.**

### **2.6.1. Results of Stock Assessment for Bigeye Tuna**

In 2015, the IATTC estimated a spawning biomass ratio of 1.06 for the BET, which means that currently, the stock of this species is not in an overfished state. Furthermore, the IATTC determined that overfishing is not occurring in the BET fishery, since the inverse of the  $F$  multiplier is estimated at 0.87.

It is important to emphasize that these results are grounded in strong and restrictive assumptions, and if stock assessment assumptions change, the results will not hold. That means that the fishery could be in a more pessimistic state given the fact that the result of any assessment is affected by a high level of uncertainty, and none of them could be following the precautionary principle. Additional to this uncertainty, are the concerns regarding the excess fishing capacity of the PS fleet in the EPO (ISSF, 2015).

The IATTC estimated the Maximum Sustainable Yield (MSY) of BET to be 113,700 tonnes. This MSY was reduced to about half its level in 1993, due to the expansion of the floating-object fishery, including fish-aggregation-devices (FADs), that did not differentiate between juvenile and adults. The latter means that reducing the catch of small BET will increase the MSY.

### **2.6.2. Results of Stock Assessment for Yellowfin Tuna**

In 2015, the IATTC determined that the YFT is being slightly overfished, since they estimated that the ratio of spawning biomass is 0.99. The IATTC argued that the level of spawning has declined in recent years, due to an increase in the fishing mortality levels for middle-age YFT since 2008.

The IATTC also concluded that overfishing is not occurring in YFT fisheries since they determined that the ratio of the current mortality and the MSY mortality (i.e. the inverse of the  $F$

multiplier) is estimated at 0.86. Again, it is important to warn that these results are highly dependent on assumptions, and to remind that previous stock assessments stated that the YFT was undergoing overfishing. Finally, the IATTC estimated that the MSY of YFT is 275,300 tonnes.

### **2.6.3. Results of Stock Assessment for Skipjack Tuna**

Finally, in the case of SJT, the IATTC concluded that:

1. There is uncertainty about the status of SJT in the EPO, especially regarding the determination of MSY reference points and biomass levels.
2. There may be differences in the status of the stock among regions; and
3. There is no evidence that indicates a credible risk to the skipjack stock(s).

To sum up, the results shown in previous sections there are serious concerns, especially for the BET and YFT fisheries, which need to be solved by improving IATTC recommended management policies for the EPO. It can also be argued that even though the 2015 IATTC stock assessment does not consider BET to be overfished, that conclusion should be treated carefully because, as previously indicated, it is highly dependent on assumptions that IATTC scientists used for their models. For instance, that result could have been more pessimistic if a different stock-recruitment relationship, a higher value for the average size of the older fish, or a lower rate of natural mortality would have been assumed, among others.

### **3. BASELINE ASSESSMENT OF THE PURSE-SEINE TUNA FLEET IN THE EASTERN PACIFIC OCEAN USING THE FISHERY PERFORMANCE INDICATORS (FPI) FOR THE TUNA FISHERIES**

#### **3.1. METHODOLOGY AND DATA**

##### **3.1.1. Fishery Performance Indicators – General Approach**

The FPI are a tool to identify management strategies that work under different combinations of exogenous factors, when the goal is not merely to achieve stock sustainability, but also to generate economic and social benefits using fishery resources (Anderson et. al. 2015). In that sense, the FPI is an innovative mechanism, since it allows the evaluation and comparison of the effectiveness of management systems across the world. Fisheries' performance is assessed through three dimensions –ecological, economic and communitarian– that gives a broader perspective and understanding of the interaction between ecosystem health and human well-being (Anderson et. al. 2015). This methodology is suitable for data poor fisheries.

To start, rather than attempting to measure a few dimensions with high precision, the FPIs identify several dimensions of greatest interest for each of the indicators analyzed. Multiple metrics are used to capture important aspects relative to each dimension, using a 1 to 5 scale that can be scored –imprecisely, but accurately–, based on expert assessment (Anderson et. al. 2015)<sup>5</sup>. In fact, these discrete bins are helpful, considering that experts face the challenge of scoring fisheries whose features can be extremely different from one another. The combination of multiple metrics facilitates robust dimension scoring, in the face of uneven availability of information, fishery expert certainty or consensus, or metric applicability to a given fishery (Anderson et. al. 2015).

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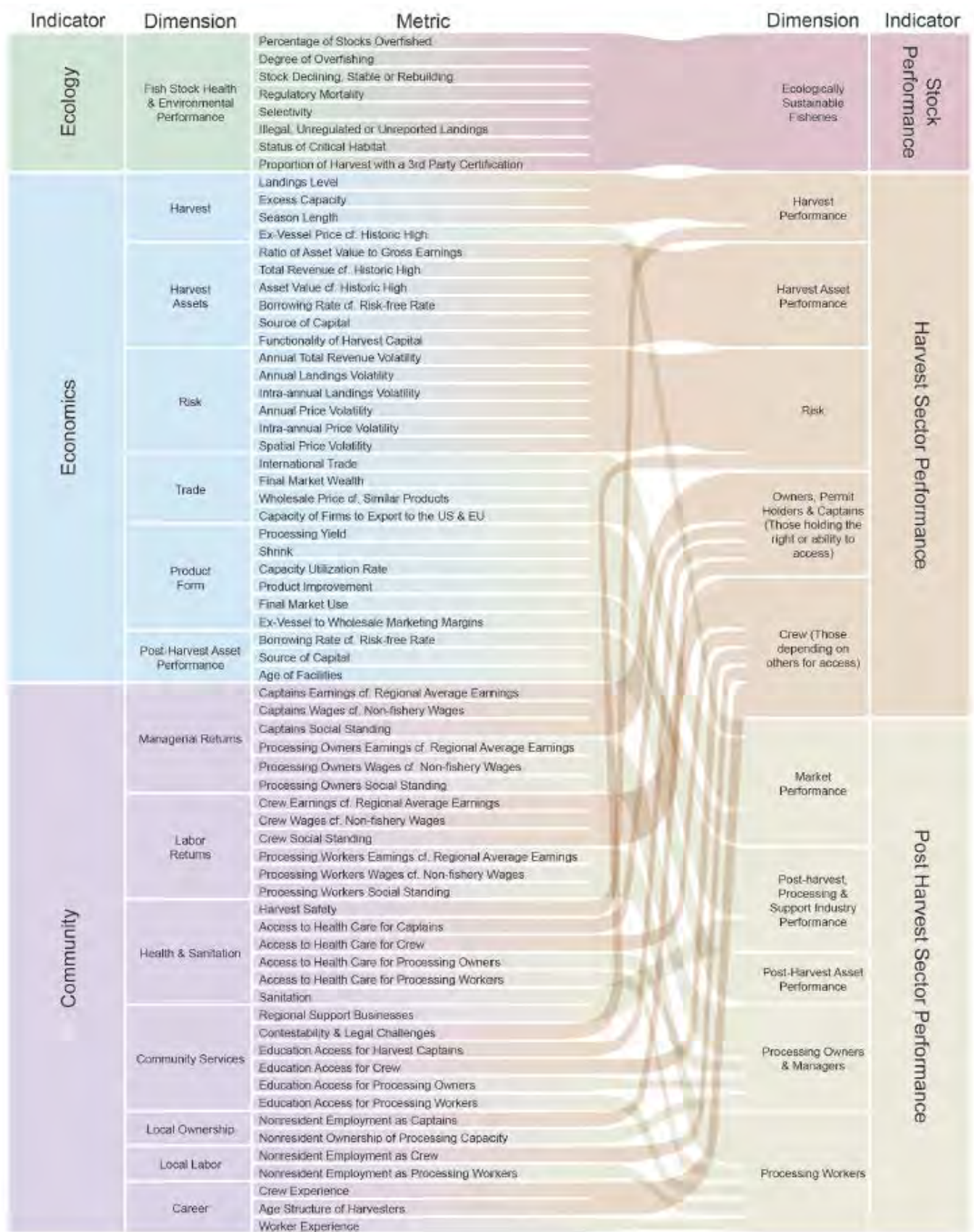
<sup>5</sup> It is necessary to clarify that the inputs and outputs scores are not monotonic, nor even are higher scores considered "better". The FPI was designed to test (using large samples) some empirical relationships between inputs and outputs. This is work in progress and therefore it is not correct (or possible) to claim that higher level of any input would improve outcomes.

The suitability of this methodology also relies on the fact that it conceptually separates dimensions that directly reflect performance of the fishery (i.e. output indicators; see Figure 8), from those that assess enabling environmental conditions, or elements of process that are conjectured to support outcomes, and are therefore often used as proxies for those outcomes (i.e. input indicators; see Figure 9) (Anderson et. al. 2015).

The FPIs are divided into two categories that are built to separate performance measures. On one hand, 68 individual outcome metrics, partitioned into sector based (or triple-bottom-line) interpretative indicators, are set to determine whether the ecosystem management applied in the fishery delivers results that are economically viable and socio-ecologically sustainable. In other words, output indicators are responsible of identifying the degree of integration between the three dimensions mentioned before (ecological, economic and social). Among others, some of the most relevant topics addressed by this category are: climate change, equity, risk/volatility, gender, and climate change. On the other hand, 54 similarly structured metrics of inputs are analyzed, since they are considered to enable the generation of socioeconomic prosperity. In fact, those are the factors that contribute to the process of incentivizing the socio-ecologically sustainable use of the fish resource. It is through the analysis of the relationships among both categories (i.e. outputs and inputs), that the possible paths towards a successful industry development arise.

To sum up, the FPI methodology is a research tool to support science-based policy. This methodology allows establishment of a baseline from which policy makers can monitor the impact of new management schemes not only on the biological dimension of the problem but also on its social and economic dimensions (Anderson et. al. 2015). Therefore, this methodology is a useful tool not only for stakeholders and fishery managers, but also for international aid agencies and NGOs.

Figure 8. Output Indicators



Source: Anderson et.al. (2015)

Figure 9. Input Indicators

| Component                        | Dimension                         | Measure                                                         |
|----------------------------------|-----------------------------------|-----------------------------------------------------------------|
| Macro Factors                    | General Environmental Performance | Environmental Performance Index (EPI)                           |
|                                  | Exogenous Environmental Factors   | Disease and Pathogens                                           |
|                                  |                                   | Natural Disasters and Catastrophes                              |
|                                  |                                   | Pollution Shocks and Accidents                                  |
|                                  |                                   | Level of Chronic Pollution (Stock effects)                      |
|                                  |                                   | Level of Chronic Pollution (Consumption effects)                |
|                                  | Governance                        | Governance Quality                                              |
|                                  |                                   | Governance Responsiveness                                       |
|                                  | Economic Conditions               | Index of Economic Freedom                                       |
|                                  |                                   | Gross Domestic Product (GDP) Per Capita                         |
| Property Rights & Responsibility | Fishing Access Rights             | Proportion of Harvest Managed Under Limited Access              |
|                                  |                                   | Transferability                                                 |
|                                  |                                   | Security                                                        |
|                                  |                                   | Durability                                                      |
|                                  |                                   | Flexibility                                                     |
|                                  |                                   | Exclusivity                                                     |
|                                  | Harvest Rights                    | Proportion of Harvest Managed with Rights-based Management      |
|                                  |                                   | Transferability                                                 |
|                                  |                                   | Security                                                        |
|                                  |                                   | Durability                                                      |
|                                  |                                   | Flexibility                                                     |
|                                  |                                   | Exclusivity                                                     |
| Co-Management                    | Collective Action                 | Proportion of Harvesters in Industry Organizations              |
|                                  |                                   | Harvester Organization Influence on Fishery Management & Access |
|                                  |                                   | Harvester Organization Influence on Business & Marketing        |
|                                  | Participation                     | Days in Stakeholder Meetings                                    |
|                                  |                                   | Industry Financial Support for Management                       |
|                                  | Community                         | Leadership                                                      |
|                                  |                                   | Social Cohesion                                                 |
|                                  | Gender                            | Business Management Influence                                   |
|                                  |                                   | Resource Management Influence                                   |
|                                  |                                   | Labor Participation in Harvest Sector                           |
| Management                       | Management Inputs                 | Labor Participation in Post-Harvest Sector                      |
|                                  |                                   | Management Expenditure to Value of Harvest                      |
|                                  |                                   | Enforcement Capability                                          |
|                                  |                                   | Management Jurisdiction                                         |
|                                  | Data                              | Level of Subsidies                                              |
|                                  |                                   | Data Availability                                               |
|                                  | Management Methods                | Data Analysis                                                   |
|                                  |                                   | MPAs and Sanctuaries                                            |
|                                  |                                   | Spatial Management                                              |
|                                  |                                   | Fishing Mortality Limits                                        |
| Post-Harvest                     | Markets & Market Institutions     | Landings Pricing System                                         |
|                                  |                                   | Availability of Ex-vessel Price & Quantity Information          |
|                                  |                                   | Number of Buyers                                                |
|                                  |                                   | Degree of Vertical Integration                                  |
|                                  |                                   | Level of Tariffs                                                |
|                                  | Infrastructure                    | Level of Non-tariff Barriers                                    |
|                                  |                                   | International Shipping Service                                  |
|                                  |                                   | Road Quality                                                    |
|                                  |                                   | Technology Adoption                                             |
|                                  |                                   | Extension Service                                               |
|                                  |                                   | Reliability of Utilities/Electricity                            |
|                                  |                                   | Access to Ice & Refrigeration                                   |

Source: Anderson et.al. (2015)

### 3.1.2. Data

The FPI, as well as other results shown in this report, are constructed using primary data that was collected through a series of interviews with: 1) Boat owners, 2) Owners of processing plants, 3) Regulators and authorities responsible for the conservation and management of tuna fisheries in the EPO, and 4) Experts and scientists. Details of these interviews are listed in Table 2.

**Table 2. List of experts and stakeholders interviewed for this study**

| Date    | Organization                                                                                      | Interviewee                                     | Position                         | Place                   | Time          |
|---------|---------------------------------------------------------------------------------------------------|-------------------------------------------------|----------------------------------|-------------------------|---------------|
| 4/06/16 | Gulf of Maine Research Institute                                                                  | Jenny Sun, PhD                                  | Senior Marine Resource Economist | Portland ME USA (Skype) | 14:00 – 16:00 |
| 4/11/16 | Eurofish S.A.                                                                                     | Giansandro Perotti & Eurofish's Executive Board | President                        | Manta Ecuador           | 11:30 - 14:30 |
| 4/12/16 | Negocios Industriales Real S.A. (NIRSA)                                                           | Roberto Aguirre                                 | Executive President              | Manta Ecuador           | 11:00 - 12:30 |
| 4/12/16 | Inter-American Tropical Tuna Commission (IATTC)                                                   | Guillermo Morán                                 | Chairman                         | Guayaquil Ecuador       | 13:30 - 15:00 |
| 5/03/16 | Servigrup S.A.                                                                                    | Bruno Leoni & Servigrup Executive Board         | President                        | Guayaquil Ecuador       | 10:00 – 13:00 |
| 5/18/16 | Independent                                                                                       | Jose Luis Garcia                                | Fishery Adviser                  | Manta Ecuador           | 17:00 – 19:00 |
| 6/26/16 | Cámara de Armadores ANDI                                                                          | Enrique de la Vega                              | Executive Director               | Bogotá, Colombia        | 15:00 – 18:00 |
| 6/27/16 | Cámara de la Industria Pesquera ANDI                                                              | Alejandro Londoño                               | Director                         | Bogotá, Colombia        | 10:00 – 13:00 |
| 6/28/16 | Autoridad de los Recursos Acuáticos de Panamá (ARAP)                                              | Zuleika Pinzon                                  | Director                         | Panamá, Panamá          | 15:00 – 17:00 |
| 6/29/16 | Fundación Internacional de Pesca (FIPESCA) & Autoridad de los Recursos Acuáticos de Panamá (ARAP) | Arnulfo Franco & Raul Delgado                   | Executive Director & Researcher  | Panamá, Panamá          | 10:00 – 13:00 |
| 7/11/16 | WWF-Japan                                                                                         | Dr. Aiko Yamauchi                               | Fisheries Project Leader         | Tokyo, Japan            | 19:00 – 21:00 |

|         |                                                 |                       |                     |                                     |               |
|---------|-------------------------------------------------|-----------------------|---------------------|-------------------------------------|---------------|
| 8/11/16 | Inter-American Tropical Tuna Commission (IATTC) | Dr. Guillermo Compean | Director            | La Joya CA, USA (Skype and written) | 16:00 – 17:00 |
| 8/15/16 | Universidad Autónoma de Baja California         | Dr. Michel J. Dreyfus | Associate Professor | Ensenada, Mexico (Skype)            | 16:00 – 18:00 |

### 3.2. RESULTS

This section contains the FPIs calculated for the main industrial scale fisheries that operate in the EPO. Specifically: 1) the PS fishery that operates using fish aggregating devices (FADs), 2) the PS fishery that sets on dolphins and 3) the industrial LL fishery that targets adult BET and YFT.

To be precise, the Ecuadorian PS fleet is the main case study for the PS fishery that sets on FADs. For the PS fishery that sets on dolphins, the case study was the Mexican PS fleet. In the case of the industrial LL fishery, the analysis was focused on the Asian LL fleet that operates in the EPO and targets both BET and YFT.

There are three sets of output indicators (i.e. Stock Performance, Harvest Sector Performance, and Post-Harvest Sector Performance) and five sets of input indicators (Macro Factors, Property Rights and Responsibility, Co-Management, Management and Post-Harvest).

Three sets of output indicators are presented and labeled as Stock Performance Indicators, one for each tuna species, that will be the same for each of the studied fleets (because these three fleets face the same stock).

For the rest of output indicators, and for all the input indicators, there is one set for each of the fleets analyzed in this study, and, if necessary, indicators are divided/classified by species. Finally, recall that each indicator was scored, using a 1 to 5 scale.

### 3.2.1. Stock Performance Indicators (Output Indicators) for the BET, YFT and SJT Fishery in the Eastern Pacific Ocean

The results shown in Table 3 allow us to conclude that each of the three-commercial species that are caught in the EPO has a different performance. Hence, by 2015, we can argue that the SJT is the most ecologically sustainable fishery in the EPO because it shows the largest score (i.e. 4.14). The second and third most ecologically sustainable fisheries in the EPO are the BET fishery (i.e. score = 4.00) and the YFT fishery (i.e. score = 3.86), respectively.

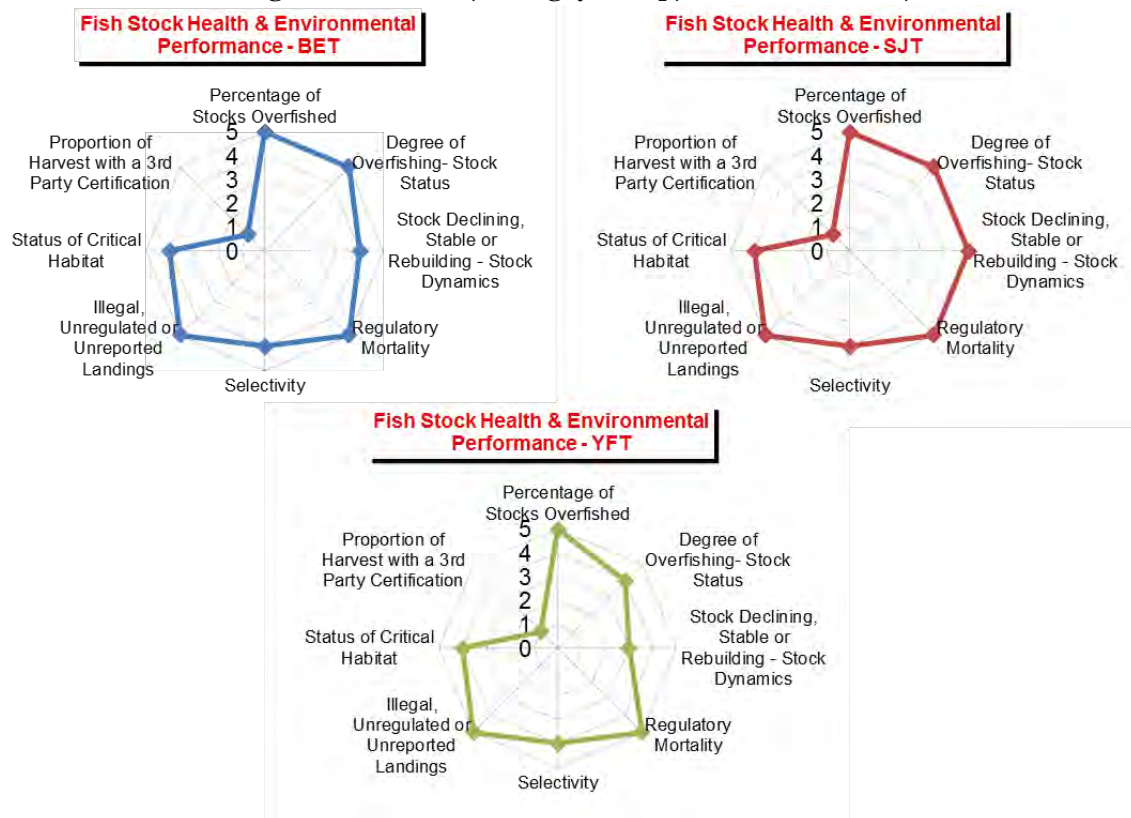
**Table 3. FPI Output Indicators – Average Stock Performance**  
Indicators for each Fishery (i.e. BET, YFT and SJT)

| SPECIES | COMPONENT         | INDICATOR                          | AVERAGE SCORE |
|---------|-------------------|------------------------------------|---------------|
| BET     | Stock Performance | Ecologically Sustainable Fisheries | 4.0           |
| SJT     |                   |                                    | 4.1           |
| YFT     |                   |                                    | 3.9           |

This can be explained mainly by the conclusions provided by the IATTC Scientific Advisory Committee (SAC) in the 2015 Fishery Status Report, summarized in section 2.6. Specifically: 1) even though there is uncertainty about the status of SJT in the EPO, there is no evidence that indicates a credible risk to the biological health of that species; 2) the BET stock is not considered to be in an overfished state (i.e.  $B/B_{MSY} = 1.06$ ); and 3) the YFT stock is considered to be slightly overfished (i.e.  $B/B_{MSY} = 0.99$ ).

Thus, based on the IATTC fishery assessment, in 2015, the SJT could be in a very good shape. On the other hand, the situation is not so optimistic for the other two commercial tuna species; (i.e. BET and YFT). to be precise, it is expected that the stocks for both tuna species will decline during the following years.

**Figure 10. Detail of the Stock Performance Indicators for each Commercial Tuna Species Caught in the EPO (i.e. Bigeye, Skipjack and Yellowfin)**



A factor that it is negatively affecting the performance of this indicator (i.e. Stock Performance) for the three-commercial species is the absence of a 3rd Party Certification for the catch of these species, for all the fleets. An important dimension of these indicators is the level of by-catch derived from the fishery activity of both PS and LL fleet. In the case of the PS fleet, the amount of by-catch as a percentage of the total catch is less than 5%. This could be considered as a low percentage, but it is a substantial problem when we analyze the by-catch in an absolute value (i.e. total weight per year), which for all the types of sets, on average, could be more than 20,000 tonnes per season (Hall and Roman 2013). It must be noted that the PS fishery bycatch is comprised of vulnerable species, including different classes of sharks and turtles. In the case of the Asian LL fleet, there is little data about the level of by-catch. Finally, the critical habitat for those fisheries (i.e. EPO) is minimally degraded, except for the proliferation of FADs and sporadic oil spills. Indicators shown in Figure 10 give the sum of all these effects.

### **3.2.2. Input and Output Indicators for the Ecuadorian Purse Seine Fleet - Eastern Pacific Ocean - Case Study for the Purse Seine Fishery that Sets on FADs**

#### **3.2.2.1. Output Indicators**

##### ***Harvest Sector Performance Component***

The fishery operation, for any of the three commercial tuna species, is highly leveraged on expensive (old) fixed assets. In addition, in 2014 and 2015, the landing volumes and the price levels of the three species have been very volatile. Both factors negatively affected the scores of the three first indicators of the Harvest Sector Performance component (Table 4). This is also aggravated by the fact that the financial sector in Ecuador is underdeveloped and, therefore, access to financial resources, to finance the working capital for periods of low cash flows, is limited by strong collateral restrictions. Furthermore, we must emphasize that only a minority of boat owners have access to funds in foreign markets; the majority is trapped under the disadvantageous conditions of the Ecuadorian financial sector.

Thus, these three first indicators of the Harvest Sector Performance component (i.e. Harvest Performance, Harvest Asset Performance, and Risks) are intimately related with the sector's capacity to generate income, and therefore, wealth.

It is expected that the volatility that affected the prices during those years will decrease in 2016 and 2017, which would improve the scores for these three indicators. However, those improvements cannot be attained unless management measures, that focus on protecting BET's and YFT's biological health, are established. This is because factors such as the excess of capacity that the EPO tuna fishery experiences, has an important negative effect on the abundance of tuna resources in the sea and the market (the former affecting the volatility of catch levels and the latter the volatility of prices).

Finally, in the case of the last two indicators of the Harvest Sector Performance component (i.e. Owners, Permit Holders & Captains and Crew), it is important to highlight that in the harvest operation, both captain and crew have good salaries and social standings. Therefore, it can be

concluded that the financial gains from the operation are also enjoyed by the crew members. This makes job positions for the harvest operation very attractive, which appeals enough skilled and efficient labor to meet production needs.

**Table 4. FPI Output Indicators – Harvest Sector Performance for the Ecuadorian PS Fleet – Case Study for the Purse Seine Fishery that Sets on FADs**

| COMPONENT                  | INDICATORS                        | BET | YFT | SJT |
|----------------------------|-----------------------------------|-----|-----|-----|
| Harvest Sector Performance | Harvest Performance               | 4.0 | 3.8 | 4.0 |
|                            | Harvest Asset Performance         | 3.3 | 3.7 | 3.3 |
|                            | Risks                             | 3.7 | 3.7 | 3.7 |
|                            | Owners, Permit Holders & Captains | 4.7 |     |     |
|                            | Crew                              | 4.0 |     |     |

### ***Post-Harvest Sector Performance Component***

In the case of the Post-Harvest Performance component, the results from Table 5 allow us to conclude that this operation is efficient. However, some of the indicators in this component are negatively impacted by some structural problems that the post-harvest sector in Ecuador suffers, such as:

1. High leverage in expensive and old (but well-maintained) fixed assets, which affects the return over assets (ROA) of the activity,
2. High volatility of product prices and low marketing margins (between ex-vessel and wholesale prices),
3. Moderate level in added value and quality of the final product (i.e. mostly canned product as finished product). This is aggravated by the fact that there is a high degree of variability of the quality of the canned products by company.

4. Highly constrained source of capital, despite the high profitability of the sector (structural problem of the Ecuadorian financial sector<sup>6</sup>).

In the case of the processing workers, their social standing is lower than those in the harvest sector, but their salaries are fair and competitive (unlike the managers, who have outstanding salaries and high social standing).

**Table 5. FPI Output Indicators – Post Harvest Sector Performance for the Ecuadorian PS Fleet – Case Study for the Purse Seine Fishery that Sets on FADs**

| COMPONENT                | INDICATORS                        | AVERAGE SCORE |
|--------------------------|-----------------------------------|---------------|
| Post-Harvest Performance | Market Performance                | 3.6           |
|                          | Post-harvest Industry Performance | 4.3           |
|                          | Post-Harvest Asset Performance    | 3.7           |
|                          | Processing Owners & Managers      | 4.5           |
|                          | Processing Workers                | 3.3           |

**Table 6. Main Producing and Exporting Countries of Canned Tuna**

| Production |             |                                    | Export |                |                                    |
|------------|-------------|------------------------------------|--------|----------------|------------------------------------|
| Rank       | Country     | Share of the Global Production (%) | Rank   | Country        | Share of the Global Production (%) |
| 1          | Thailand    | 24.1                               | 1      | Thailand       | 40.1                               |
| 2          | Ecuador     | 11.9                               | 2      | Ecuador        | 9.0                                |
| 3          | Philippines | 7.4                                | 3      | Spain          | 7.8                                |
| 4          | Spain       | 7.2                                | 4      | Philippines    | 5.7                                |
| 5          | Mexico      | 6.1                                | 5      | Indonesia      | 4.6                                |
| 6          | Samoa       | 4.3                                | 6      | Mauritius      | 3.7                                |
| 7          | Korea       | 3.6                                | 7      | Seychelles     | 3.4                                |
| 8          | Italy       | 3.5                                | 8      | Cote de Ivoire | 3.4                                |
| 9          | Maurice     | 2.9                                | 9      | China          | 2.1                                |
| 10         | Colombia    | 2.8                                | 10     | Netherlands    | 2.1                                |

<sup>6</sup> The main structural problem of the Ecuadorian financial sector is that the interest rate is regulated and artificially fixed. This makes it difficult for financial institutions to match the interest rate required to their customers with the level of individual risk thereof. Consequently, these financial institutions are forced to look up for alternative ways to mitigate their risk. One such alternative is to increase the financial and collateral requirements for their customers, which in many cases reach prohibitive levels, and become a sizeable restriction in access to credit for many companies. In addition, the financial sector is also subjected to state-directed allocation of credit, and a high level of taxes. Both factors limit the access of this sector to foreign investment which further restricts banks' credit operations.

Lastly, it is necessary to recognize that the post-harvest sector in Ecuador is highly respected and recognized worldwide. Ecuador is the second most important producer and exporter of canned tuna in the world (Table 6). Manta is recognized as the most important processing cluster in the EPO, because of its high capacity level and efficiency. For this reason, Manta's processing plants are used not only by the Ecuadorian fleet, but also by fleets from Colombia, Panama, Costa Rica, European Union, among others. All this confirms previous conclusions, that the sector is highly efficient but affected by some external factors that need to be solved in the medium term.

### **3.2.2.2. Input Indicators**

Table 7 shows the results obtained for the input indicators for the Ecuadorian PS Fleet that operates in the EPO and sets on FADS.

**Table 7. FPI Input Indicators for the Ecuadorian PS Fleet – Case Study for the Purse Seine Fishery that Sets on FADs**

| COMPONENTS                       | INDICATORS                        | AVERAGE SCORE |
|----------------------------------|-----------------------------------|---------------|
| Macro Factors                    | General Environmental Performance | 4.0           |
|                                  | Exogenous Environmental Factors   | 4.4           |
|                                  | Governance                        | 2.0           |
|                                  | Economic Conditions               | 2.0           |
| Property Rights & Responsibility | Fishing Access Rights             | 3.8           |
|                                  | Harvest Rights                    | 1.0           |
| Co-Management                    | Collective Action                 | 3.0           |
|                                  | Participation                     | 4.0           |
|                                  | Community                         | 4.0           |
|                                  | Gender                            | 1.8           |
| Management                       | Management Inputs                 | 4.5           |
|                                  | Data                              | 4.0           |
|                                  | Management Methods                | 1.7           |
| Post-harvest                     | Markets & Market Institutions     | 3.0           |
|                                  | Infrastructure                    | 3.7           |

For the component labeled as Macro Factors, the indicators that scored higher are General Environmental Performance and Exogenous Environmental Factors. In the case of the General Environmental Performance indicator, we used the Environmental Performance Index (EPI) developed by researchers from Yale University and Columbia University (EPI, 2011). The EPI tracks 10 policy categories covering both environmental public health and ecosystem vitality. The EPI ranges from 1 to 100. In the case of Ecuador, its EPI was 66.58 in 2016. This puts the country in the fourth quintile in the EPI, and consequently, Ecuador obtains a score of four for the General Environmental Performance indicator.

In the case of the Exogenous Environmental Factors indicator, the Ecuadorian PS fleet obtained a high score (i.e. 4). This was because this fleet's harvest has been consistently unaffected by diseases, natural disasters<sup>7</sup> and pollution shocks. However, this indicator does not score a perfect 5 because the harvest has been consistently affected by a minimal detectable level of chronic pollution of mercury. The latter has had a minimal effect on the consumption of the Ecuadorian product, so therefore it does not greatly affect the profitability of the activity. However, given that it is a latent issue, it should be considered seriously, especially because most of the Ecuadorian product goes to environmental/health conscious markets, such as the USA and the European Union.

On the other hand, for this Macro Factors component, the indicators that scored lower are Governance and Economic Conditions. The Governance indicator uses the World Bank's Worldwide Governance Indicators (WGI) as a reference. The WGI consists of six dimensions, but the FPI regroup them into two categories:

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<sup>7</sup> An exception to this is the negative effect produced by the earthquake that hit Manta on April 16<sup>th</sup>, 2016. This natural disaster reduced the harvest value in less than 10%, because post-harvest operation was interrupted during approximately three weeks. For that reason, even though it was an isolated case, we decided to give a score of 4 to the metric labeled as Natural Disasters and Catastrophes.

1. ***Governance Quality Dimension***, which is composed by the following four WGI: Effectiveness, taking the average of Government Effectiveness (GE), Regulatory Quality (RQ), Rule of Law (RL), and Control of Corruption (CC); and
2. ***Governance Responsiveness Dimension***, which is constructed by averaging the following two WGI: Voice and Accountability (VA) and Political Stability (PS).

The results for Ecuador are given in Table 8. From those results, we can conclude that the general perceptions regarding regulatory quality and effectiveness, ability to implement sound policies, confidence in the quality of property rights, and the corruption situation in Ecuador, are relatively low and could be greatly improved.

**Table 8. Dimensions for the Governance Indicator –for the Ecuadorian PS fleet that sets on FADs**

| Worldwide Governance Indicators      | FPI Categories/Governance Dimensions |                           |
|--------------------------------------|--------------------------------------|---------------------------|
|                                      | Governance Quality                   | Governance Responsiveness |
| Government Effectiveness             | -0.50                                |                           |
| Regulatory Quality                   | -1.02                                |                           |
| Rule of Law                          | -1.05                                |                           |
| Control of Corruption                | -0.82                                |                           |
| Voice and Accountability             |                                      | -0.26                     |
| Political Stability                  |                                      | -0.01                     |
| <i>Average</i>                       | <i>-0.85</i>                         | <i>-0.14</i>              |
| <i>FPI Score</i>                     | <i>1</i>                             | <i>3</i>                  |
| <i>Governance Indicator Score: 2</i> |                                      |                           |

The Economic Conditions indicator is composed of two economic dimensions. The first one is the Index of Economic Freedom (IEF) developed by The Heritage Foundation and The Wall Street Journal, which helps to evaluate 10 components of freedom (i.e. government spending, fiscal freedom, trade freedom, monetary freedom, labor freedom, financial freedom, business freedom, investment freedom, property rights and freedom from corruption). The second dimension is Gross Domestic Product per Capita based on the data from the World Bank. For

Ecuador, the IEF was of 48.6, a score that is below the world's average (i.e. 60.7) and even beneath the regional average (i.e. 59.9). Consequently, under the FPI protocol, we provide a score of 1 for this country in the dimension of Economic Freedom. Moreover, Ecuador's GDP per capita, adjusted by purchasing power parity, was of US\$11,388; this provides a score of 3 in this dimension. Thus, Ecuador obtained a score of 2 for the Economic Condition Indicator. The fact that this indicator is low is not a cause of concern, because the tuna sector depends almost 90% on foreign consumption, and therefore, on foreign economic conditions. The Governance indicator for the Ecuadorian tuna sector is not worrisome either, because the sector is highly integrated with the world market, and it is more affected by US/EU market and legal stipulations, than by local ones.

In the case of the Property Rights and Responsibility component, the Access Rights indicator is affected by: 1) the free participation of artisanal fleets in the EPO that are hardly regulated, 2) the fact that the vessels' carrying capacity, and implicitly the rights to fish, belong to the government and not to the boat, and 3) the prevalent confusion about both the titular and the legal extent of the capacity rights. These problems introduce some level of institutional uncertainty for the Ecuadorian tuna sector. In spite of those problems, the score is fairly healthy, and can be improved by specific governmental actions focusing on providing more confidence to the sector, which would strengthen their fishing rights. On the other hand, Direct Harvest Rights (for target species) for the PS fleet (e.g. Territorial Use Rights for Fishing, Individual Vessel Quotas, Individual Transferable Quotas, among others) are not well developed and/or do not exist in the EPO, and for that reason, that indicator received the lowest score possible (i.e. 1).

The indicators of the Co-Management component show high scores, except for the Collective Action and the Gender indicators. The Collective Action indicator is affected by the inability of the Ecuadorian harvester organizations to influence marketing aspects of the business, including prices. This is a problem considering both the high volatility that those prices suffered during 2014 and 2015, and their low level during the same period, which negatively affected the

profitability of the business (i.e. both the harvest and post-harvest business). On the other hand, there is a structural problem with the Gender indicator, related to the non-participation of women in the harvest sector, and their low participation in both business and resource management activities. However, it is important to highlight that women have an important participation in the post-harvest sector, composing the majority of its workforce. Finally, the two remaining indicators (i.e. Community and Participation) of the Co-Management component evidence that the tuna sector in Ecuador is highly organized and cohesive, with clear leadership in place, and with few social problems that impose social distance among their members (i.e. rivalries between locals and Spaniards, as well as between the Manta sector and the Posorja sector).

Regarding the Management component, the scores for the Management Inputs and the Data indicators are high. This reflects the IATTC's management effectiveness in the EPO. The Management Inputs indicator is only slightly affected (negatively) by specific idiosyncratic problems related to the fiscal policies in Ecuador (i.e. the fact that Ecuador maintained a fuel subsidy). Similarly, the Data indicator is slightly negatively affected because most the data that is gathered and analyzed by the IATTC, is exclusively biological. There are few economic data, and scarce economic analysis of the tuna fishery in the EPO. Ecuador has not completed any actions to correct this problem, and for that reason, it is expected that this gap in economic information will persist in the medium term.

In the case of the Management Methods indicator, the score is low (i.e. 1.7). This constitutes an inherent problem of the FPI methodology, because its definition of effective methods is the “*simultaneous*” implementation of Marine Protected Areas (MPAs), Spatial Management and Fishing Mortality Limits. However, the IATTC applies other set of management policies (the fishing vessel register, the closure periods, El Corralito, catch limits for Asian LL, among others) that are not contemplated by this methodology. Therefore, a score of 1.7 is not a fair representation of the different actions that the IATTC is taking to protect the tuna resource in the EPO, and it is only the result of an incomplete characterization of the Management Method

indicator by the FPI methodology. However, the latter does not mean that it is not necessary to consider implementing spatial management methods for the tuna fisheries in the EPO, such as those contemplated by the FPI.

Finally, in the case of the Post-Harvest component, the Market & Market Institutions indicator is the one that shows the lowest score. This is because of three reasons: 1) a lack of a transparent daily pricing mechanism in the Ecuadorian market; 2) a moderate degree of vertical integration (even though it is a norm to sign long term contracts to increase efficiency in the sector and reduce transaction costs); and 3) a high tariff level for the export of canned tuna. For the Infrastructure indicator, the score is high. This may be attributed to: 1) the improvement of the public infrastructure since 2009, 2) Manta's high development as a cluster for the tuna operations (i.e. harvest and post-harvest activities) in the South Region of the EPO, and 3) Manta's access to all the required support business. The only disadvantages are the lack of extension services, and the expensive international shipping services, compared to other countries such as Costa Rica, Panama and even Colombia.

### **3.2.3. Input and Output Indicators for the Mexican Purse Seine Fleet - Eastern**

#### **Pacific Ocean - Case Study for the Purse Seine Fishery that Sets on dolphins**

##### ***3.2.3.1. Output Indicators***

##### ***Harvest Sector Performance Component***

First, as we indicated previously, in 2014, 95% of the total catch of the Mexican PS fleet was YFT; for that reason, the analysis will focus on that species for the indicators belonging to this component. As in the case of the Ecuadorian fleet, the Mexican fleet is also highly leveraged in expensive fixed assets, which affects the score of the Harvest Asset Performance indicator. In addition, like the Ecuadorian case, the Mexican fleet was also affected by a high volatility in both

the landing and price levels of YFT during 2014 and 2015. The latter factors negatively affected the scores of the three first indicators of the Harvest Sector Performance component (Table 9).

However, the impact of the fluctuation of the world tuna prices on the Mexican tuna sector was lower than the impact on the Ecuadorian tuna sector, because, as discussed later, the Mexican tuna sector is more homogeneous, integrated and compact. Furthermore, other reasons that could explain the lower impact of and the large volatility of the tuna prices on the profitability of the Mexican fleet include: 1) greater access to a financial sector that is well developed, with more and better conditions to finance the short-term requirements of the industry; and 2) a highly specialized operation in YFT in an almost exclusive fishing area (i.e. the northern area of the EPO).

**Table 9. FPI Output Indicators – Harvest Sector Performance for the Mexican PS Fleet –  
Case Study for the Purse Seine Fishery that Sets on Dolphins**

| COMPONENT                  | INDICATORS                        | AVERAGE SCORE |
|----------------------------|-----------------------------------|---------------|
| Harvest Sector Performance | Harvest Performance               | 4.0           |
|                            | Harvest Asset Performance         | 3.7           |
|                            | Risks                             | 4.0           |
|                            | Owners, Permit Holders & Captains | 5.0           |
|                            | Crew                              | 4.8           |

It is necessary to remember that these indicators are also affected by management measures that focus on protecting the biological health of the three commercial tuna species. Among these policies, the ones that aim to control the excess capacity in the EPO are highlighted. Thus, any improvements in these policies could benefit the indicators of the Harvest Sector Performance component.

Finally, regarding the last two indicators of the Harvest Sector Performance component, it is important to highlight that, like in Ecuador, for the harvest operation both captains and crew have good salaries and social standing. Thus, in Mexico it is also very attractive to have a job in

the harvest operation sector, which will engage enough qualified and efficient labor to satisfy the production requirements.

### ***Post-Harvest Sector Performance Indicator***

The results from Table 10 demonstrate that the Mexican Post-Harvest operation is highly efficient.

The Mexican tuna industry is highly integrated. In Mexico, four companies (i.e. Pesca Azteca, Grupomar, Herdez del Fuerte and Procesa) comprise 95% of the total catch, 99% of the sales in the local market, and 100% of total exports. These four companies are highly (vertically) integrated, owning vessels and processing plants. Their processing plants are constantly renewed, to maintain high levels of quality and efficiency. These four companies also have their own docks, with excellent facilities; therefore, operating losses are almost nonexistent. Furthermore, it should be noted that these four companies own dockyards for the repair and maintenance of their vessels, as well as a privileged access to regional business support, because of proximity to the USA. Based on the Post-Harvest Industry Performance indicator (Figure 11) it can be concluded that the Post-Harvest Sector in Mexico is more efficient than the one in Ecuador.

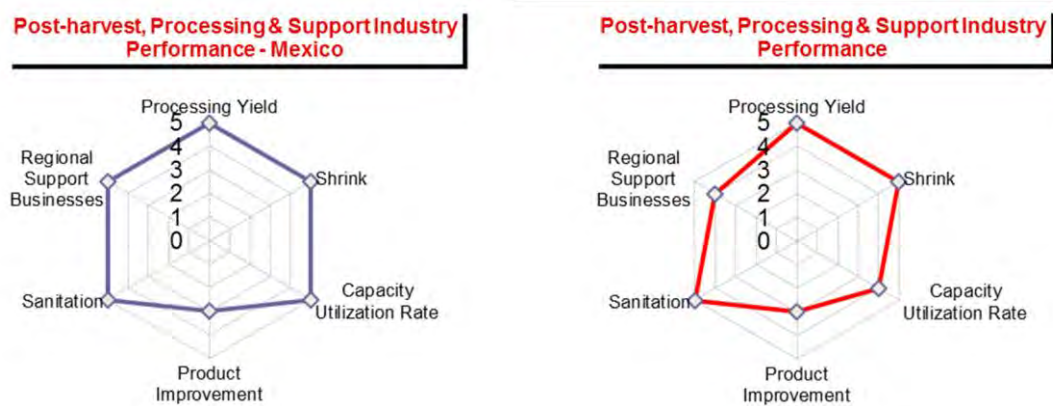
**Table 10. FPI Output Indicators – Post Harvest Sector Performance for the Mexican PS Fleet – Case Study for the Purse Seine Fishery that Sets on Dolphins**

| COMPONENT                | INDICATORS                        | AVERAGE SCORE |
|--------------------------|-----------------------------------|---------------|
| Post-Harvest Performance | Market Performance                | 2.9           |
|                          | Post-harvest Industry Performance | 4.7           |
|                          | Post-Harvest Asset Performance    | 4.3           |
|                          | Processing Owners & Managers      | 4.5           |
|                          | Processing Workers                | 4.0           |

However, as observed in Table 10, not all the indicators of the Post-Harvest Performance component show a perfect score of 5. There are some issues that have negatively affected some of the indicators, and that require improvement. Among these factors, we have:

1. High volatility of product prices and low marketing margins (between ex-vessel and wholesale prices).
2. High dependence on the local market (i.e. Mexico), where approximately 95% of the products are sold, principally due to the USA's embargo on the fishery over dolphins. This increases the income risk of the operation, because in the long-term, the Mexican economy has shown to be very volatile.
3. Moderate level in added value and quality of the final product. This sector produces mostly canned tuna as finished product.

**Figure 11. Post-harvest, Processing & Support Industry Performance for Ecuador and Mexico**



In the case of the processing workers, their social standing is lower than in the harvest sector, but their salaries are fair and competitive. On the other hand, the processing plant managers have excellent (and competitive) salaries, and a high social standing; however, in contrast with the

Ecuadorian case, Mexican managers have more alternative job opportunities in Mexico, and therefore, a more aggressive system of compensation is needed to keep them in their positions.

### **3.2.3.2. Input Indicators**

Table 11 shows the results obtained for the input indicators for the Mexican PS Fleet that operates in the EPO and sets on dolphins.

**Table 11. FPI Input Indicators for the Mexican PS Fleet –  
Case Study for the Purse Seine Fishery that Sets on Dolphins**

| COMPONENTS                       | INDICATORS                        | AVERAGE SCORE |
|----------------------------------|-----------------------------------|---------------|
| Macro Factors                    | General Environmental Performance | 5.0           |
|                                  | Exogenous Environmental Factors   | 4.8           |
|                                  | Governance                        | 2.5           |
|                                  | Economic Conditions               | 4.0           |
| Property Rights & Responsibility | Fishing Access Rights             | 4.7           |
|                                  | Harvest Rights                    | 1.0           |
| Co-Management                    | Collective Action                 | 3.7           |
|                                  | Participation                     | 4.0           |
|                                  | Community                         | 5.0           |
|                                  | Gender                            | 3.0           |
| Management                       | Management Inputs                 | 4.5           |
|                                  | Data                              | 5.0           |
|                                  | Management Methods                | 1.7           |
| Post-harvest                     | Markets & Market Institutions     | 3.8           |
|                                  | Infrastructure                    | 5.0           |

From all the indicators of the Macro Factors Component, Governance was the one that scored lowest. The results for the different metrics that composed the Governance Indicator are provided in Table 12. From those results, we conclude that Mexico has had problems in promoting an effective rule of law and strengthening its legal framework. The judicial system remains vulnerable to political interference, which generates political instability, especially for local governments (Miller and Kim, 2016). Therefore, there are various determinants of the Governance

indicator that have a great potential to be improved in the coming years. Despite those governance problems, Mexico shows good performance in the Economic Condition indicator. This could be explained by the high degree of resilience of the Mexican economy, in the face of a challenging global economic environment. Reform efforts related to enhancing regulatory efficiency and liberalizing investment regimes, have continued in many areas. This has attracted an important amount of foreign direct investment in the last 5 years. The fact that the Mexican economy is relatively healthy and stable in the short and medium term is important for the tuna sector, because most of its products are sold locally, and therefore, the profitability of the sector is highly correlated with the performance of the Mexican economy.

**Table 12. Dimensions for the Governance Indicator for the Mexican PS fleet that sets on dolphins**

| Worldwide Governance Indicators        | FPI Categories/Governance Dimensions |                           |
|----------------------------------------|--------------------------------------|---------------------------|
|                                        | Governance Quality                   | Governance Responsiveness |
| Government Effectiveness               | 0.19                                 |                           |
| Regulatory Quality                     | 0.43                                 |                           |
| Rule of Law                            | -0.45                                |                           |
| Control of Corruption                  | -0.40                                |                           |
| Voice and Accountability               |                                      | -0.05                     |
| Political Stability                    |                                      | -0.76                     |
| <i>Average</i>                         | <i>-0.14</i>                         | <i>-0.41</i>              |
| <i>FPI Score</i>                       | <i>3</i>                             | <i>2</i>                  |
| <i>Governance Indicator Score: 2.5</i> |                                      |                           |

In the case of the General Environmental Performance indicator, we found that the EPI for Mexico was 73.59 in 2016. Then, Mexico is in the fifth quintile in the EPI, and obtains a score of five for the General Environmental Performance indicator.

In addition, in the case of the Exogenous Environmental Factors indicator, like the Ecuadorian product, the Mexican product is also affected by the existence of a level of chronic pollution of mercury. This pollution in the product is minimal, and it does not have any impact on

its consumption level, because 95% of the product is sold locally in a market that is more interested in other product attributes such as availability and affordability.

In the case of the Property Rights and Responsibility component, the Access Rights indicator is high (i.e. 4.7). The latter indicator is only affected for the fact that the vessels' carrying capacity quota, and consequently the rights to fish in the EPO, belong to the government of the country of origin of the vessels and not to the vessel owners.

Something that is necessary to highlight from the interviews, is we were informed that the Mexican Government considers the tuna sector to be an important sector. For that reason, Mexico's Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food has designed a Plan of Fisheries Management for the YFT<sup>8</sup>. This includes the implementation of both a monitoring and a research program, aimed at continually analyzing the biological and the economic health of the resource, and thereby, determining whether additional conservation measures to those proposed by the IATTC are required.

The government has also shown extraordinary support to the tuna industry through its legal efforts to overturn the US embargo during the last 30 years. Hence, because of this strong ties between the Mexican government and the tuna industry, it can be concluded that there is no uncertainty about their fishing rights, a situation that favors long term investments in the sector.

The indicators of the Co-Management component show high scores, except for the Collective Action and the Gender indicators. The Collective Action indicator is affected by the inability of the Mexican tuna organizations (such as the Pacific Alliance for Sustainable Tuna<sup>9</sup>) to influence marketing aspects of the business, including prices. Tuna prices are determined internationally by the Asian market. For this reason, Mexican tuna producers are exposed to the high volatility of tuna prices (like the situation experienced in 2014 and 2015), without any mechanism to control it. On the other hand, in the case of the Gender indicator, even though the

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<sup>8</sup> <http://www.inapesca.gob.mx/portal/documentos/Planes-de-Manejo-Pesquero/Golfo/PLAN-DE-MANEJO-PESQUERO-ATUN-ALETA-AMARILLA.pdf>

<sup>9</sup> <http://www.pacifictunaalliance.org/about/members.html>

result is low, the degree of women participation is adequate not only for the post-harvest sector, but also for positions related to the business and resource management sectors.

Conversely, the two other indicators (i.e. Community and Participation) show that the Mexican tuna sector is highly organized and cohesive. This result was expected, given the high concentration of the industry in four companies, which facilitates their ability to coordinate and work towards common objectives (i.e. an example of this organization capacity is the formation of the Pacific Alliance for Sustainable Tuna).

The scores of the Management Inputs and Data indicators (both as part of the Management component) are high. This reflects the IATTC's management effectiveness in the EPO. The Management Input indicator is slightly affected (in a negative way) by the existence of a fuel subsidy for the Mexican fleet. In the case of the Data indicator, even though the data gathered by the IATTC is exclusively biological, there is a valid system in Mexico to collect economic data, which helps to close the IATTC information gap. This system of collection of economic information is promoted by two Governmental offices: CONAPESCA and INPESCA (Instituto Nacional de Pesca). On the other hand, in the case of the Management Methods indicator, it should be emphasize as stated previously, that the low score is related to a problem of the FPI methodology, specifically, its narrow definition of what is considered as an optimal set of management strategies.

Finally, in the case of the Post-Harvest component, the Market & Market Institutions indicator is the one that scores the lowest. This is because of the impossibility of the Mexican product to enter the USA market due to the embargo. This situation has forced the Mexican Industry to depend on the local market. However, the high degree of vertical integration of the Mexican industry has favored the efficient flow of information, helping them to better manage this fishery. This situation does not apply to the five boats that do not belong to the four big companies, which face important problems when selling their products. Furthermore, the participation of organizations outside the industry, such as universities and NGOs, with a set of extension services

focused on transferring knowledge and technology to all the members of the sector, has promoted a continuous improvement in the efficiency of both harvest and post-harvest operations for the tuna industry in Mexico.

### **3.2.4. Input and Output Indicators for the Asian Industrial Longline Fleet - Eastern Pacific Ocean - Case Study for the Industrial Longline Fishery that Targets Adult Bigeye and Yellowfin Tunas**

The results of this section will be based on the analysis of the Asian LL fleet, which comprises 942 vessels from China (358), Chinese Taipei (155), Japan (238) and Korea (191). The Asian fleet was chosen not only because it is the largest in number of vessels, but also due to its catch level. Specifically, in 2014, 88.7% of the total catch of the LL fleets that operate in the EPO, was caught by these Asian vessels.

This group of vessels, that operates in the EPO, is one of the seven types of Asian LL vessels that work along the Pacific Ocean. Specifically, these LL vessels are part of a group of boats known as “The tropical distant-water BET/YFT-target fishery fleet”. This fleet is composed of distant-water vessels from Japan, Korea, Chinese-Taipei, and mainland China that operates in the eastern tropical waters of the Western Central Pacific Ocean (WCPO) and into the EPO. As the name indicates, the main species caught by this fleet are BET and YFT, intended for the frozen sashimi market.

In this section, a set of FPIs will be generated based on the opinion of experts and information gathered from the literature. It is important to emphasize that, based on the information provided by the experts and the literature, we were not able to determine all the required indicators, particularly those related to the post-harvest operation. This is not a problem because the Asian LL fleet will not constitute a major part of any EPO business plan. However, it is important to emphasize that we could obtain sufficient information to characterize the harvest

operation of this fishery. This characterization is essential for the elaboration of any EPO business plan (unlike the information of the post-harvest operation), because of the direct impact that these harvest activities have on the abundance of the tuna resources in the geographical area of study.

### **3.2.4.1. Output Indicators**

#### ***Harvest Sector Performance Indicator***

The industrial LL fishery targets two species: BET and YFT. For that reason, the analysis will only focus on those two species.

Compared to the PS fishery, there are a greater number of safety concerns regarding the industrial LL fishery, since the number of people who died during its operation is higher. The harvest assets of the industrial LL fleet are older than the harvest assets of the PS fleet, and the level of maintenance of the industrial LL fleet is lower, both in its quality and frequency. Furthermore, the owners of Asian LL boats finance their operations with somewhat expensive credit that require personal collateral.

**Table 13. FPI Output Indicators – Harvest Sector Performance for the Asian Industrial LL Fleet – Case Study for the LL Fishery that Targets BET and YFT in the EPO**

| COMPONENT                  | INDICATORS                        | BET | YFT |
|----------------------------|-----------------------------------|-----|-----|
| Harvest Sector Performance | Harvest Performance               | 3.8 | 3.5 |
|                            | Harvest Asset Performance         | 3.0 | 3.0 |
|                            | Risks                             | 4.1 | 4.0 |
|                            | Owners, Permit Holders & Captains | 4.0 |     |
|                            | Crew                              | 3.3 |     |

However, like the PS fleet, the LL fleet is also exposed to the volatility of price and landing levels of BET and YFT. A relatively high price, with small volatility, is crucial for the profitability of this fishery because its production costs are high, and its fishing behavior follows a price strategy instead of a volume one. If the prices are lower than what is required to cover the ever-increasing production costs, it is expected that this fleet's participation in the EPO will diminish, and

therefore, vessels will prefer to maintain their operations in the WCPO. Dr. Aiko Yamauki, who was interviewed for this report, noted that the phenomenon described above has been observed in the last 5 years.

Finally, in the case of the last two indicators of the Harvest Sector Performance component (i.e. Owners, Permit Holders & Captains and Crew), it is important to highlight that for the LL fleet, the compensation for captain and owners is not as good as it is for the PS fleet from the American continent. According to the experts, the amount of money that boat owners and even captains generated, is equivalent to the money that they would have been able to make in an office job (i.e. equivalent to the salaries received by supervisors in an industrial plant). Furthermore, salaries for the crew members are not competitive, and their social standing is low, which makes it difficult for boat owners to attract efficient and skilled labor for the fishing operation. As a consequence, the crew is mostly old, and its average age is increasing year after year.

### ***Post-Harvest Sector Performance Indicator***

The Post-Harvest Performance component was out of the scope of this project due to the reasons stated previously. Due to limited information, we were not able to fully characterize the LL Asian Post-Harvest Sector. Basic information from interviewed experts highlighted that this sector is highly influenced by only one company, Mitsubishi Co., which has a great market power leveraged in its sizeable share of the world frozen sashimi market (between 30% and 40%).

**Table 14. FPI Output Indicators – Post Harvest Sector Performance for the Asian Industrial LL Fleet – Case Study for the LL Fishery that Targets BET and YFT in the EPO**

| COMPONENT                | INDICATORS                        | AVERAGE SCORE |
|--------------------------|-----------------------------------|---------------|
| Post-Harvest Performance | Market Performance                | 3.4           |
|                          | Post-harvest Industry Performance | NA            |
|                          | Post-Harvest Asset Performance    | NA            |
|                          | Processing Owners & Managers      | NA            |
|                          | Processing Workers                | NA            |

Furthermore, it is necessary to emphasize that the (LL) fresh/frozen post-harvest operations are more complex than the (PS) canned post-harvest operations, due to the former's multiple product forms and distribution channels.

An indicator that we could fully characterize within the Post-Harvest Performance component is the one related to the Market Performance. This indicator received a score of 3.4. Its score was affected by the characteristics and the usage of the final product. The catch of the Asian LL fleet is mainly intended for the sashimi frozen market, which is considered a high value consumption market. The product is sold mainly in Japan, Korea, Thailand and China, which are markets with a stable economy and high purchasing power.

#### ***3.2.4.2. Input Indicators***

Table 15 shows the results obtained for the input indicators for the Asian LL Fleet that operates in the EPO, and targets BET and YFT.

The Macro Factors component show high scores for most of its indicators. This is because the LL fleet analyzed are from countries with remarkable economic conditions, which can even be considered developed countries (i.e. Japan and Korea). However, it is necessary to emphasize, that the Governance indicator is the lowest one. This is because China is among the group of countries analyzed, a country affected by deep-rooted structural problems such as: overreliance on public investment and exports for growth, a state-controlled financial sector, and regulatory inefficiency (Miller and Kim, 2016).

Regarding the Exogenous Environmental Factors indicator, this is affected by the negative impact that natural disasters and catastrophes have on the harvest value. Specifically, referring to the annual cycle of tropical cyclone formations in the WCPO, that according to the experts' responses, produces a contraction in the harvest value of this fleet in a range between 15% and 20%. Also, as in the case of the PS fishery in the EPO, this fishery is affected by a minimal level of chronic pollution of mercury in its product. However, the latter is not a problem because

consumers provide more weight to other product attributes such as continuous and immediate availability.

**Table 15. FPI Input Indicators for the Asian Industrial LL Fleet – Case Study for the LL Fishery that Targets BET and YFT in the EPO**

| COMPONENTS                       | INDICATORS                        | AVERAGE SCORE |
|----------------------------------|-----------------------------------|---------------|
| Macro Factors                    | General Environmental Performance | 5.0           |
|                                  | Exogenous Environmental Factors   | 4.4           |
|                                  | Governance                        | 3.5           |
|                                  | Economic Conditions               | 4.0           |
| Property Rights & Responsibility | Fishing Access Rights             | 4.3           |
|                                  | Harvest Rights                    | 1.0           |
| Co-Management                    | Collective Action                 | 3.0           |
|                                  | Participation                     | 3.5           |
|                                  | Community                         | 2.5           |
|                                  | Gender                            | 1.0           |
| Management                       | Management Inputs                 | 4.3           |
|                                  | Data                              | 3.0           |
|                                  | Management Methods                | 2.7           |
| Post-harvest                     | Markets & Market Institutions     | 2.3           |
|                                  | Infrastructure                    | 4.3           |

In the case of the Property Rights & Responsibility component, the Fishing Access Right indicator shows a high score. This is because the fishing rights in this geographic area are strongly protected by the governments. The only downside is that the capacity of transferring those rights among individuals is the exclusive authority of the government. In addition, as in the case of the PS fishery, there is no individual catch rights for the participant vessels, even though there is an implicit catch limit for the fleet but they are granted to the governments of the countries of origin of the vessels.

The indicators of the Co-Management component are the ones that show the lowest scores. This is because the Asian LL fleet is highly heterogeneous, not only between countries but also within each country. Thus, despite the existence of harvester organizations, they are not cohesive enough to have an important impact on the management decisions of each country. This is mostly due to a lack of leadership and a low level of organization around common objectives.

Hence, social heterogeneity and lack of leadership are the main factors behind the poor organization and the weak collective action of the individuals who are part of this fleet. In addition, female participation is very low in all the levels, operations and management sectors of the businesses.

The score of the Management Inputs indicator is high. This reflects the management effectiveness of the IATTC in the EPO. However, in the case of the Data indicator, its score (i.e. 3) is lower than the one for the Ecuadorian and Mexican PS fleets (i.e. 4 and 5 respectively). This is because there is no economic data, and even though the catch data of this fleet is reliable, the collection of biological data is deficient (most of this information came from Japanese vessels only). Specifically, China, Korea and Chinese Taipei did not provide biological data readily and reliably. Hence, there is great uncertainty about the by-catch data; that is, it is suspected that there is an enormous discrepancy between what it is reported by China, Korea and Chinese Taipei and what was really caught. There are also doubts about the level of compliance of these fleets with the appropriate protocols for the management of the by-catch.

On the other hand, in the case of the Management Method indicator, the score is higher than the one obtained for the PS fleets because catch limits are in place for the Asian LL fleet (one for each of the four participant countries). However, we should emphasize again that this indicator suffers from a problem in the definition of optimal management tools.

As indicated previously, both the literature and the interviewed experts lack information about the post-harvest sector of this LL fishery. However, they were able to inform that the post-harvest sector for the frozen sashimi product is practically a monopsony. Mitsubishi Co. has great market power which is leveraged in its impressive market share between 30 and 40% of the world market. This distorts the landings price system as well as the profitability for the Asian LL fleet.

Lastly, for the Infrastructure indicator, the score is high, something that was expected, because the countries of origin of the LL vessels that analyzed are highly developed and therefore it is expected to have high quality public services, public roads, technology access and shipping

services. The only weakness, as in many countries in the world, is the lack of extension services focused on training fishery participants on the best fishing practices available.

## 4. CONCLUSIONS

Analysis in this report covered the economic and ecological sustainability of three fisheries in the EPO: The Ecuadorian PS tuna fleet (as a case study of the PS fleet that sets on FADs), the Mexican PS tuna fleet (as a case study of the PS fleet that sets on dolphins) and the Asian Industrial LL tuna fleet. For this purpose, the FPI methodology, developed by Anderson, et. al. (2015) was used to assess baseline performance of these three fisheries.

When applying the FPI methodology to the three tuna fisheries in the EPO we found that both the BET and YFT fisheries show a tendency towards the over-exploitation of the resources, with the probability of worsening during the coming years. The possible reasons behind this problem is that these fisheries are managed exclusively through access rights; that is, there are not fishing rights intended to control the intensity in the application of fishing effort. This issue could affect the profitability of the activity in the long term; however, in the short term, some negative effects have already been noticeable, such as an increase in the volatility of both the price and the landing levels.

Something that is important to emphasize from the FPI findings is the high degree of efficiency of the analyzed PS fleets (that operate in the EPO), both in their harvest and post-harvest operations. However, despite this high level of efficiency, the final product derived from these operations is not high value-added or premium, but a moderate value-added human consumption product; that is, canned tuna. This could be considered as a loss of opportunity to make the most from the efficiency obtained throughout the entire production chain.

In addition, although production systems for tuna PS fisheries in the EPO show a high level of efficiency; that does not mean they do not face specific problems that need to be mitigated

or eliminated. For instance, the PS fleet that sets on FADs (like the Ecuadorian PS fleet) caught most of the juvenile BET and YFT that is fished in the EPO. If this situation it is not reversed it can affect the long-term economic sustainability of the tuna fishery in the EPO. On the other hand, the PS fleet that sets on dolphins (like the Mexican PS fleet), faces some market problems. Specifically, they face strong trade barriers to introduce their product to the US market. Experts argued that this is a problem that affects the profitability of this fleet; however, it is unclear what additional revenues may be generated if this market was accessible, because of competition with other canned tuna products<sup>10</sup>.

In the case of the LL (Asian) fleet, its operating costs have been increasing year by year, while both the prices of the products decrease and the volatility of these prices increases each year. This forces Asian longliners to primarily limit their activity to the WCPO, rather than traveling further to the EPO.

To sum up, the tuna fisheries in the EPO are still profitable and generate important economic and social returns; however, this activity is economically threatened by the possible over-exploitation of the resources, due to unsustainable fishing practices, overcapacity and a lack of regulations whose focus goes beyond measures to control catch levels.

Hence, given the previous perspective, and based on the results obtained from our FPI analysis<sup>11</sup>, we recommend to consider the following actions when designing any business plan for the EPO:

1. The tuna fisheries in the EPO are managed exclusively by fishing access rights, as well as effort and spatial closures. It is important to seriously consider the implementation of harvest rights that help to control the excessive effort that is applied, especially on

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<sup>10</sup> In addition, it is unclear what the level of exports would be, as currently Mexico's production cannot fully supply its domestic market demand.

<sup>11</sup> Although there is no strong empirical relationship between the inputs and outputs of the FPI, we use the results derived from this methodology as evidence to confirm the results obtained from previous research (Allen et. al. 2010) which among other things, claim the need to implement rights-based management measures or capacity reduction policies to improve the profitability of the fishing activity of the tuna sector in the EPO.

the populations of both BET and YFT juveniles. A good start could be the implementation of an individual vessel quota scheme for the BET and YFT that are caught through sets on FADs by the PS fleet. This program could be the first of many, whose objectives are not only to protect the biological health of the three commercial tuna species but also the economic health of the fisheries in the EPO.

2. The main factor that affected the score of the *Ecologically Sustainable Fisheries Indicator* is the lack of a third-party certification for all the tuna fisheries in the EPO. Then, it is advisable to promote and support any effort to certify those tuna fisheries, to improve the standard of the harvest operations in the EPO.
3. It is generally claimed, that the main objective for management of the tuna fisheries in the EPO is to protect both the biological health of the species, as well as the economic health of the fishing activities. Then, if preserving the profitability of the tuna fisheries is as important as protecting the biological health of the marine resources in the EPO, it is necessary to establish a program to collect economic information that is as effective as the IATTC program that currently collects catch and biological data.
4. The *Harvest Performance Indicator* was negatively affected by the low score of the dimension Excess Capacity; therefore, it is necessary to work on policy alternatives or programs that focus on reducing both the active and latent capacity of PS vessels in the EPO (e.g. a buyback program)<sup>12</sup>. This would improve the harvest performance, financially and operatively; and
5. There are business opportunities that can be capitalized from increasing the scope and diversification of the final product and/or enhancing the quality of the lower-end product. For that purpose, it is recommended to invest on market research to identify

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<sup>12</sup> It is necessary to emphasize that buyback programs are transition schemes towards to a more rationalized fishery (e.g. a fishery under a rights-based management framework). Thus, buyback programs alone do not modify individual incentives to both over-invest and over-fish. Therefore, these programs should be considered as a means towards an end, specifically, the implementation of a management system with a well-defined set of property rights.

those business opportunities that favor the production of higher value added product with a higher markup, which can improve the financial return (per pound) of the catch.

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## ANNEX 1

### FISHERY PERFORMANCE INDICATORS (FPI) FOR THE PURSE SEINE FLEET FROM COLOMBIA AND PANAMA.

This Annex contains a succinct analysis of the Panamanian PS tuna fleet (as another case study for the PS fleets that sets on FADs), and the Colombian PS fleet (as another case study for the PS fleets that sets on dolphins). Both fleets share the characteristic of using the Ecuadorian processing capacity to produce canned tuna from their catch.

The degree in which these two countries use the Ecuadorian processing capacity is dissimilar. Colombia processes between 50% and 70% of its tuna catch in Ecuador, while Panama processes 100% of its catch at Ecuadorian processing plants. The reasons for this dependence on the Ecuadorian (tuna) post-harvest sector are different for each of these two countries. On one hand, the Colombian fleet processes a significant percentage of their catch at Ecuadorian plants for the following reasons:

1. Criminal groups, left-wing guerrillas and right wing paramilitaries<sup>13</sup> have made the most important (as well as accessible and suitable because of its draught) Colombian port on the Pacific Ocean (i.e. Buenaventura) to be prohibitively dangerous. Consequently, it is virtually impossible to land product at that port. This has resulted in the Colombian tuna processing industry maintaining its capacity in the ports of Barranquilla and Santa Martha, on the Atlantic coast. Hence, while the harvest operation is performed in the Pacific Ocean, the Colombian PS vessels are forced to pass through the Panama Canal in order to deliver the product to the processing plants on the Atlantic. This is an important

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<sup>13</sup> *Colombia: Disappearances Plague Major Port.* <https://www.hrw.org/news/2014/03/20/colombia-disappearances-plague-major-port>

*The Crisis in Buenaventura.* <https://www.hrw.org/report/2014/03/20/crisis-buenaventura/disappearances-dismemberment-and-displacement-colombias-main>

*Colombia: New Killings, Disappearances in Pacific Port.* <https://www.hrw.org/news/2015/03/04/colombia-new-killings-disappearances-pacific-port>

financial burden for the Colombian tuna industry. For that reason, a more cost efficient strategy is to land its catch in Manta, Ecuador.

2. Labor costs for the Colombian post-harvest sector are, on average, 1.7 times higher than the labor costs in Ecuador (Zuleta & Becerra, 2013).

On the other hand, the Panamanian PS tuna fleet lands 100% of their catch in Ecuador because Panama does not have any processing plants in its territory. This has been a consequence of the country's fishing regulations, in which it has established that:

1. The tuna fishery with purse seines is prohibited in the territorial waters of the Republic of Panama (Executive Decree 239 - July 15, 2010); and
2. The use of longlines by commercial and industrial tuna fishing vessels in the territorial waters of the Republic of Panama is prohibited (Executive Decree 486 - December 28, 2010).

Therefore, both the Colombian and the Panamanian fleets are practically an extension of the Ecuadorian fleet, and their dependence on the Ecuadorian post-harvest sector has strengthened Manta's business and strategic position as a tuna "hub" in South America.

The next section will provide a summary of the results of the FPIs for both countries (i.e. Colombia and Panama), in an attempt to complement the analysis conducted in the main body of this document.

## **A1.1. Input and Output Indicators for the Colombian Purse Seine Fleet**

### ***A1.1.1. Output Indicators***

#### ***Harvest Sector Performance Component***

The fishery operation of the Colombian PS fleet is also highly leveraged in expensive and old fixed assets. Furthermore, during 2014 and 2015, the Colombian PS fleet was also affected by the high volatility of both the landing and the price levels of the three-tuna species. Both factors negatively

affected the scores of the three first indicators of the Harvest Sector Performance component (Table A1.1).

In addition, the scores for the Owners, Permit Holders & Captains indicator and the Crew indicator, are negatively affected by the fact that the majority of the labor for those positions is foreign. To be precise, virtually none of the captains are local, and in the case of the crew only an approximate 20% is Colombian<sup>14</sup>. Then, the harvest operation is highly leveraged on foreign labor, which is more efficient, more experienced, cheaper, and, from a legal point of view, easier to hire.

**Table A1.1. FPI Output Indicators – Harvest Sector Performance for the Colombian PS Fleet**

| COMPONENT                  | INDICATORS                        | BET | YFT | SJT |
|----------------------------|-----------------------------------|-----|-----|-----|
| Harvest Sector Performance | Harvest Performance               | 4.0 | 3.8 | 4.0 |
|                            | Harvest Asset Performance         | 3.0 | 3.2 | 3.0 |
|                            | Risks                             | 2.9 | 3.3 | 3.0 |
|                            | Owners, Permit Holders & Captains | 4.3 |     |     |
|                            | Crew                              | 3.9 |     |     |

Finally, something that should be highlighted is that the Colombian financial sector is more developed than the Ecuadorian sector. Consequently, Colombian boat owners have better access to credit, under more favorable conditions.

### ***Post-Harvest Sector Performance Component***

The indicators of the Post-Harvest Performance component are mostly positive (Table A1.2). The Market Performance indicator is the one with the lowest score. It is affected by the high volatility of tuna prices, the low wholesale marketing margins, and the low diversification of final markets, principally due to the US embargo, which stops Colombian product from being sold in US markets (because Colombian tuna is caught mostly with sets on dolphins).

Other factors that negatively affected the Post-Harvest indicators, preventing them from reaching a perfect score, are the following:

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<sup>14</sup> The majority of the crew; that is, almost 80% is from Ecuador.

1. The post-harvest sector is leveraged in expensive and old (but well-maintained) fixed assets, which affects the ROA of the activity.
2. There is a moderate level in added value and quality of the final product (i.e. mostly canned product as finished product).
3. Manager wages are more competitive in Colombia, which forces the tuna processing industry to be more aggressive to protect and retain the human capital.
4. There is a lack of support businesses for the post-harvest sector, because neither Barranquilla nor Santa Martha are a tuna cluster like Manta.

In the case of the processing workers, most of them are Colombians and, like in the case of Ecuadorian post-harvest workers, their social standing is low, but their salaries are fair and competitive in relation to alternative jobs that they can aspire.

**Table A1.2. FPI Output Indicators – Post Harvest Sector Performance  
for the Colombian PS Fleet**

| COMPONENT                | INDICATORS                        | AVERAGE SCORE |
|--------------------------|-----------------------------------|---------------|
| Post-Harvest Performance | Market Performance                | 3.3           |
|                          | Post-harvest Industry Performance | 3.8           |
|                          | Post-Harvest Asset Performance    | 3.7           |
|                          | Processing Owners & Managers      | 4.7           |
|                          | Processing Workers                | 3.9           |

### ***A1.1.2. Input Indicators***

Table A1.3. shows the results obtained for the input indicators for the Colombian PS Fleet that operates in the EPO.

For the component labeled as Macro Factors, the indicators that scored higher are General Environmental Performance, Exogenous Environmental Factors, and Economic Conditions. For the General Environmental Performance indicator, we used the EPI, which for Colombia was of

75.93 in 2016. This puts Colombia in the fifth quintile in the EPI, and consequently, it obtains a score of five for the General Environmental Performance indicator.

**Table A1.3 FPI Input Indicators for the Colombian PS Fleet**

| COMPONENTS                       | INDICATORS                        | AVERAGE SCORE |
|----------------------------------|-----------------------------------|---------------|
| Macro Factors                    | General Environmental Performance | 5.0           |
|                                  | Exogenous Environmental Factors   | 4.6           |
|                                  | Governance                        | 2.5           |
|                                  | Economic Conditions               | 4.5           |
| Property Rights & Responsibility | Fishing Access Rights             | 3.5           |
|                                  | Harvest Rights                    | 1.0           |
| Co-Management                    | Collective Action                 | 3.0           |
|                                  | Participation                     | 3.5           |
|                                  | Community                         | 5.0           |
|                                  | Gender                            | 2.0           |
| Management                       | Management Inputs                 | 4.8           |
|                                  | Data                              | 4.0           |
|                                  | Management Methods                | 1.7           |
| Post-harvest                     | Markets & Market Institutions     | 3.0           |
|                                  | Infrastructure                    | 3.8           |

Regarding the Exogenous Environmental Factors indicator, the Colombian PS fleet obtained a high score (i.e. 4.6). This was because this fleet's harvest has been consistently unaffected by diseases, natural disasters and pollution shocks. However, as the other PS fleets that operate in the EPO, the Colombian product has been regularly affected by a minimal detectable level of chronic pollution of mercury. This has had a minimal effect on the consumption of the Colombian product, and a very low impact on the profitability of the sector.

The score for the Economic Condition indicator is 4.5. This score is relatively high, especially when compared to the Ecuadorian (i.e. 2.0) and Mexican (i.e. 4.0) scores. This is because Colombia has been characterized for having strong economic fundamentals (such as macroeconomic stability and openness to global trade and finance), which has helped the economy to expand, on average, 5% per year, over the past five years.

On the other hand, within the Macro Factors component, the indicator that scored the lowest is Governance. This is because Colombia is still affected by internal conflicts, including the armed conflict that it is expected to end this year (i.e. 2016). The violence derived from drug trafficking activities is another problem that has eroded Colombian institutions. Although this situation has improved during the last 5 years, there is still a lot of work that needs to be done (Miller and Kim 2016). A detailed description of the different components of the Governance indicator is given in Table A1.4.

**Table A1.4. Dimensions for the Governance Indicator for the Colombian PS fleet**

| Worldwide Governance Indicators        | FPI Categories/Governance Dimensions |                           |
|----------------------------------------|--------------------------------------|---------------------------|
|                                        | Governance Quality                   | Governance Responsiveness |
| Government Effectiveness               | -0.11                                |                           |
| Regulatory Quality                     | 0.50                                 |                           |
| Rule of Law                            | -0.34                                |                           |
| Control of Corruption                  | -0.39                                |                           |
| Voice and Accountability               |                                      | -0.10                     |
| Political Stability                    |                                      | -1.12                     |
| <i>Average</i>                         | <i>-0.09</i>                         | <i>-0.61</i>              |
| <i>FPI Score</i>                       | <i>3</i>                             | <i>2</i>                  |
| <i>Governance Indicator Score: 2.5</i> |                                      |                           |

For the Property Rights and Responsibility component, the Access Rights indicator is affected by the fact that the vessels' carrying capacity, and implicitly the rights to fish, belong to the government and not to the boat owners. Furthermore, those rights are valid for the short term, and must be continually renewed. These generates institutional uncertainty for the Colombian tuna sector. However, those problems can be solved by a stronger commitment of the Colombian government to protect the fishing rights of the boat owners. On the other hand, as indicated previously, Harvest Rights do not exist in the EPO and for that reason that indicator received the lowest score possible (i.e. 1).

The indicators within the Co-Management component that show the lowest scores are the Collective Action and the Gender indicators. Like in the case of the Ecuadorian and the Mexican tuna sector, the Collective Action indicator for the Colombian sector is affected by the inability of Colombian harvester organizations to influence marketing aspects of the business, including prices. On the other hand, there is a structural problem with the Gender indicator, related to the non-participation of women in the harvest sector, and their low participation in both business and resource management activities. However, it is important to highlight that women have a very important participation in the post-harvest sector. Finally, the two other indicators (i.e. Community and Participation) of the Co-Management component, suggest that the tuna sector in Colombia is homogenous, highly organized and socially cohesive.

For the Management component, the scores of the Management Inputs indicator and the Data indicator are high. Again, this is related to the IATTC's management effectiveness in the EPO. The only problem, as we discussed previously, is the lack of economic data to improve the management of the Colombian fleets, as well as the other fleets that operate in the EPO. Lastly, the score for the Management Methods indicator is low (i.e. 1.7), because, as previously stated, there is an inherent problem with the FPI' methodology regarding its narrow definition of what are considered optimal tools for fishery management.

In the case of the Post-Harvest component, the Market & Market Institutions indicator is the one that shows the lowest score. This is mainly due to 1) a lack of a transparent daily pricing mechanism in Colombia, and 2) the US embargo that stops the Colombian canned product from entering the US market. Finally, the score for the Infrastructure indicator is higher than the score for the Market & Market Institutions indicator, but lower than 4. This can be attributed to two reasons: 1) the poor road quality in Colombia, and 2) the lack of extension services that help to improve the operation and the practices, in both the harvest and the post-harvest sectors.

## A1.2. Input and Output Indicators for the Panamanian Purse Seine Fleet

### A1.2.1. Output Indicators

#### *Harvest Sector Performance Component*

Similar to the other PS fleets that operate in the EPO, the ROA of the Panamanian PS fleet is affected by its high leverage on expensive and old (but well maintained) fixed assets. Moreover, like the other PS fleets analyzed in this report, during 2014 and 2015, the Panamanian PS fleet was affected by the increase in price and landing volatility (Table A1.5).

Approximately 50% of the captains are local, while the fleet is owned by Panamanians. On the other hand, only a third of the crew is Panamanian; most of the crew is Ecuadorian. Since it is more attractive to work on freighters than on fishing boats, boat owners of the Panamanian PS fleet are forced to hire foreign labor.

A significant factor that affects the Risk Indicator is that the Panamanian PS fleet is not allowed to fish in Panamanian territorial waters. This situation reduces the Risk indicator score to the lowest level, when compared to the scores obtained by the other fleets analyzed in this report.

**Table A1.5. FPI Output Indicators – Harvest Sector Performance for the Panamanian PS Fleet**

| COMPONENT                  | INDICATORS                        | BET | YFT | SJT |
|----------------------------|-----------------------------------|-----|-----|-----|
| Harvest Sector Performance | Harvest Performance               | 4.0 | 3.8 | 4.0 |
|                            | Harvest Asset Performance         | 3.7 | 4.0 | 3.3 |
|                            | Risks                             | 3.3 | 3.3 | 2.7 |
|                            | Owners, Permit Holders & Captains | 4.7 |     |     |
|                            | Crew                              | 3.8 |     |     |

It is important to emphasize that Panama is the financial hub of Latin America. Therefore, Panamanian boat owners can obtain low interest loans with very advantageous conditions.

Finally, when asked about Panamanian boats maintaining their flag despite both the prohibition of fishing in the Panamanian territorial waters and the lack of processing plants in this country, experts answered that both the access to credit, and the flexible tax policies are unique conditions that cannot be found in another country in the region.

### ***A1.2.2. Input Indicators***

Table A1.6. shows the results obtained for the input indicators for the Panamanian PS Fleet that operates in the EPO.

For the General Environmental Performance indicator, we used the EPI, which for Panama was of 78 in 2016. Because of this score, Panama was granted a score of five in the General Environmental Performance indicator.

**Table A1.6. FPI Input Indicators for the Panamanian PS Fleet**

| <b>COMPONENTS</b>                | <b>INDICATORS</b>                 | <b>AVERAGE SCORE</b> |
|----------------------------------|-----------------------------------|----------------------|
| Macro Factors                    | General Environmental Performance | 5.0                  |
|                                  | Exogenous Environmental Factors   | 4.6                  |
|                                  | Governance                        | 3.0                  |
|                                  | Economic Conditions               | 4.0                  |
| Property Rights & Responsibility | Fishing Access Rights             | 4.3                  |
|                                  | Harvest Rights                    | 1.0                  |
| Co-Management                    | Collective Action                 | 3.3                  |
|                                  | Participation                     | 3.5                  |
|                                  | Community                         | 4.5                  |
|                                  | Gender                            | 1.0                  |
| Management                       | Management Inputs                 | 4.8                  |
|                                  | Data                              | 4.0                  |
|                                  | Management Methods                | 1.7                  |
| Post-harvest                     | Markets & Market Institutions     | 2.7                  |
|                                  | Infrastructure                    | 4.0                  |

The Panamanian PS fleet has been consistently unaffected by diseases, natural disasters and pollution shocks. However, it has been affected by a minimal detectable level of chronic pollution of mercury. This pollution has had a minimal effect on the consumption of the Panamanian product, which is sold entirely through Ecuadorian marketing channels.

The score for the Economic Condition indicator is 4. This score is justified by the notable economic expansion that Panama has experienced in the last five years, which is sustained by openness to global commerce and pro-growth market reforms. Conversely, the indicator that scored the lowest is Governance, since Panama still has some inefficiency problems in its

regulatory frameworks, and in its judicial system, which is also overburdened and weak (Miller and Kim, 2016).

**Table A1.7. Dimensions for the Governance Indicator for the Panamanian PS fleet**

| Worldwide Governance Indicators        | FPI Categories/Governance Dimensions |                           |
|----------------------------------------|--------------------------------------|---------------------------|
|                                        | Governance Quality                   | Governance Responsiveness |
| Government Effectiveness               | 0.27                                 |                           |
| Regulatory Quality                     | 0.37                                 |                           |
| Rule of Law                            | -0.09                                |                           |
| Control of Corruption                  | -0.36                                |                           |
| Voice and Accountability               |                                      | -0.26                     |
| Political Stability                    |                                      | -0.01                     |
| <i>Average</i>                         | <i>0.05</i>                          | <i>0.24</i>               |
| <i>FPI Score</i>                       | <i>3</i>                             | <i>3</i>                  |
| <i>Governance Indicator Score: 3.0</i> |                                      |                           |

For the rest of the input indicators, the situation is similar to the other PS fleets that operate in the EPO:

- Vessels' carrying capacity and the rights to fish belong to the government and not to the boat owners. However, in Panama, these rights are fully protected, as long as the boats do not fish in Panamanian waters.
- Panamanian harvester organizations are unable to influence marketing aspects of the business, including prices.
- Women do not participate in the harvest sector, and participation is low both in the business and resource management activities.
- Social cohesion between the members of the tuna sector is high, and there is a clear leadership from a small group of individuals, which provides vision for management and is able to attract stakeholders to that vision; and

- The Panamanian tuna industry lacks a post-harvest sector, and is dependent on the processing sector in Ecuador. This constitutes a disadvantage, because the Panamanian tuna sector is not only affected by the world price conditions, but also by idiosyncratic distortions that specifically affect the Ecuadorian tuna sector.

## ANNEX 2

### FPI SUPPLEMENT - ACCESS PAYMENTS

In this Annex, we will analyze a FPI supplement focused on Access Payments related to leasing activities of the rights to fish in a specific jurisdiction. According to Dr. Chris Anderson, “this supplement is meant to score rights leasing arrangements, including access payments, quota auctioning and reflagging arrangements, that provide access to fish in the Exclusive Economic Zone (EEZ) of, or otherwise allocated to, another country. This supplement should be scored from the perspective of the country with the rights to the fish being leased”.

As in the case of the original FPI, this supplement’s components are divided into two groups: output and input/enabling conditions. Specifically, this supplement has three output components (i.e. payment, lessor state industry and domestic fleets), and five input components (i.e. agreement scope, lessor governance, lessee governance, management and enforcement, and rights properties of leased access).

In this Annex, we will also examine each component and its different measures. We will also show the results derived from testing the supplement with two PS fleets: the Ecuadorian and the Colombian fleets.

#### A2.1. Output Components

##### *A2.1.1. Output Component 1: Payment*

##### ***Measure: Size of Payment to Value Received***

For this measure, we need to calculate the value of the lease payment, as a percentage of the value of the harvesting entities' ex vessel revenues. In Ecuador’s case, the lease payment for a 3-year fishing permit, renewable for two more years, is of approximately \$150,000. On the other hand, boat owners in Colombia must pay a fishing permit fee of approximately \$750 per year, as well as an average annual patent payment of \$10,000, for class 6 vessels. Then, for both Colombia and

Ecuador, the lease payment represents less than 5% of the revenues from for the additional rights provoked by the permit. For this reason, both countries scored a 2 in this measure.

***Measure: Size of Payment to Local Value***

In this measure, the value of the lease payment as a percentage of the value of landing the same fish locally is registered. This is intended to capture if the fish is being "sold out from under" the local fishing community for less than it is worth, or if it is being leased to harvesters who can get much more value for it and transfer more value to the coastal state. If the quantity leased would overwhelm the local market, then it is appropriate to reduce the score one or two levels. For instance, 50% could be chosen as an answer (i.e. alternative 3) to account for the fact that economic return would be about half if the country incurred the risk and cost of harvesting itself. For our specific case, we considered that for both countries (i.e. Ecuador and Panama), the return of the leased fleet is equal to the local fleet. Because at the end, the necessity of having an active leased fleet for each of these two countries is to be able to have enough product so that processors operate always at full capacity.

***Measure: Use of Payment***

This measure requires the identification of the portion of the payment that is directed to support the coastal communities that might benefit from a domestic fishery, if the fish were harvested domestically. In Ecuador, between \$20,000 and \$40,000 per boat per year are destined to finance the INP (Instituto Nacional de Pesca), while in Colombia, 100% of the payment is directed to the government, to finance its current spending. For both countries, the money collected through the lease payment is used on general government expenditures; therefore, both countries were given a score of 2 in this measure.

### ***A2.1.2. Output Component 2: Lessor State Industry***

#### ***Measure: Lessor State Crew Employment***

This measure considers the portion of the crew on harvesting vessels who come from the lessor country. Something that it is important to highlight is that this measure's score is related to the actual level of employment, and not to the level required in the agreement. In Ecuador, 70% of the crew is local, and 30% of the crew is foreign. On the other hand, the local crew in Colombia represents only approximately 15% of the total crew (this low percentage is related to the difficulty to find skilled and efficient fishing labor in Colombia). Therefore, Ecuador was given a score of 4, while Colombia was given a score of 3.

#### ***Measure: Lessor State Processing***

This measure attempts to capture the proportion of catch that is harvested under the leasing arrangement processed in the lessor state. In the Ecuadorian case, 100% of the catch that is caught by the lessee state's fleet is processed in Ecuador. On the contrary, in the Colombian case, less than 5% of the catch of the lessee state's vessels is processed in the country. Therefore, Ecuador scored a 5 in this measure, while Colombia scored a 1.

#### ***Measure: Lessor State Processing Ownership***

This measure is related to the proportion of catch harvested under the leasing arrangement, that is processed by processing plants owned by residents of the lessor state. In Ecuador's case, 100% of the catch is processed in plants that belong to Ecuadorians. On the contrary, in Colombia this percentage is zero; this means that the 5% of the catch that is processed in Colombia, is processed at plants that belong to foreigners. Consequently, Colombia obtained a score of 1 for this measure, while Ecuador obtained a score of 5.

### ***A2.1.3. Output Component 3: Domestic Fleets***

#### ***Measure: Competition with Domestic Fleets***

This measure focuses on the reduction in harvest (or value of harvest) by established domestic fleets of the lessor state, associated with the harvest by the lessee state. Reduction in value may be due to depletion, or at-sea or onshore competition that affects the fish value. In both cases (Ecuador and Colombia), the domestic fleet is not affected by the activity of the lessee state's fleet. Therefore, both Colombia and Ecuador scored a 5 in this measure.

#### ***Measure: Conflict with Domestic Fleets***

This measure is related to the different conflicts that could arise between established domestic fleets of the lessor state, and the fleets of the lessee state. In both countries there has not been any sign of conflict. Thus, we assigned a score of 5 for both Ecuador and Colombia.

## **A2.2. Input/Enabling Conditions Components**

### ***A2.2.1. Input Component 1: Agreement Scope***

#### ***Measure: Resource Use Restriction***

This measure tries to measure how effective the agreement restrictions are at preventing overfishing of key species. In Ecuador and Colombia, the leasing agreements attempt to target harvests (i.e. limit the catch to some species only), and to establish limits to any growth in the capacity, after the lessee signed the agreement. Due to these conditions, we scored both countries with a 4.

#### ***Measure: Parties to Agreement Structure***

Through this measure, we analyze the structures' governing access to the lessee's resource. In other words, this measure measures both the transparency and robustness of the agreements. In

Ecuador and Colombia, the agreements are established under transparent and robust frameworks. In consequence, both countries received a score of 5.

### ***A2.2.2. Input Component 2: Lessor Governance***

#### ***Measure: Corruption Index***

For this measure, we used the World Bank Control of Corruption Index (WBCCI). Ecuador is in the 28<sup>th</sup> percentile, which is equal to a score of 2 in this measure. On the other hand, Colombia is in the 55<sup>th</sup> percentile, which is equal to a score of 3 in this measure. This measure could be redundant with the Governance Component, which was already determined in the original FPI.

#### ***Measure: Good Country Index***

This measure aims to characterize the multilateral reputation of the lessor country. For that purpose, we use the quintile score of the World Order sub-index of the Good Country Index (GCI - <https://goodcountry.org/index/overall-rankings>). Both countries (Ecuador and Colombia) are in the third quintile (i.e. Ecuador = 76 and Colombia = 66); therefore, we scored both countries with a 3 in this measure. Again, we consider that this component and these measures are redundant with the Governance measure of the original FPI.

### ***A2.2.3. Input Component 3: Lessee Governance***

For this component, we used the same two measures that were used to construct the Lessor Governance component. The author does not specify how should the two measures be weighted when there is more than one lessee country. For that reason, we calculated a simple average; even though we consider that this is not the best approach, it is the most straightforward.

Ecuador generally provides access rights (i.e. rights that allow foreign boats to fish in Ecuador's EEZ as well as other benefits such as getting advantage over the national fuel subsidies)

to vessels from Colombia, Panama and Costa Rica. On average, these three countries are located in the WBCCI's 56<sup>th</sup> percentile, and in the GCI's 4<sup>th</sup> quintile. In consequence, we scored the Corruption and Good Country Indexes with a 3 and a 4, respectively.

On the other hand, Colombia generally leases its fishing right to boats from Ecuador, Panama and Costa Rica. On average, these three countries are located in the 47<sup>th</sup> percentile of the WBCCI, and in the 4<sup>th</sup> quintile of the GCI. Consequently, the Corruption index is given a score of 3, and the Good Country Index is given a score of 4.

We re-emphasize that this is a confusing component, since the way in which the score for multiple countries should be averaged is not specified. Therefore, we recommend to the FPI authors to be more explicit about how to deal with this issue.

#### ***A2.2.4. Input Component 4: Management and Enforcement***

##### ***Measure: Lessee Reporting***

This measure relates to the proportion of landings that are reported, for purposes of management. For the cases of both Colombia and Ecuador, given that the lessee countries' boat should comply with the IATTC regulations, we assigned a score of 5 in this measure.

##### ***Measure: Lessee Management Contribution***

This measure measures the involvement of the lessee country in providing scientific expertise or money to support the management of target species in the lessor country. In Ecuador and Colombia, lessee countries do not contribute to the management of harvested stocks. Therefore, we provided a score of 2 to both countries in this measure.

***Measure: Enforcement***

This measure measures the lessor country's ability to limit the lessee's activity to abide by relevant fishing regulations and restrictions on fishing, included within the terms of the agreement. Given that Ecuador and Colombia have a high capacity to monitor and enforce all key terms of the agreement, we scored both countries with a 5.

***A2.2.5. Input Component 4: Rights Properties of Leased Access******Measure: Transferability Index***

In Ecuador and Colombia, it is not possible for lessees to transfer their access rights to other boats. Therefore, we provided a score of 1 for both countries in this measure.

***Measure: Security Index***

This measure is related to the extent to which the government may change or reduce the access rights. In Colombia and Ecuador, access rights are fully respected by the government; consequently, we assigned a score of 5 to both countries.

***Measure: Durability Index***

In Ecuador, access rights last three years and are renewable up to two additional years. For that reason, Ecuador was given a score of 3. Conversely, in Colombia the rights are virtually indefinite; they last one year but can be renewed indefinitely without any restriction. For that reason, Colombia received a score of 5 in this measure.

***Measure: Flexibility Index***

This measure is related to the right holders' flexibility regarding timing and production technology employed. In both countries, all decisions about time of harvest, gear used and handling practices, are under their control. Therefore, Colombia and Ecuador received a score of 5 for this measure.

***Measure: Exclusivity Index***

This measure is related to the ability of right holders to exclude all those who do not hold the right, from affecting the resource or the market. Ecuador and Colombia assure that those who are granted access rights, are not affected by intrusion of the unauthorized fleet. Therefore, both countries scored a maximum of 5 for this measure.

**A2.3. Recommendation – Additional Measure or Component**

It is recommended that this supplement includes an component (or measure) to assess the legal responsibility when there is a transgression or a breach in the agreement or the law by a vessel from the lessee country. There is a lot of heterogeneity on this aspect among IATTC countries. For instance, in Colombia and in Ecuador, boats from lessee states are sponsored by local processing firms, to be able to apply for an access agreement. Hence, if there is a violation (of the law or the agreement), the subjects that should be held responsible are different. In Ecuador, only the boat owner is held responsible, while in Colombia, both the boat owner and the sponsoring firm are responsible. It is very likely that this heterogeneity exists among other countries; therefore, it is advisable to consider the introduction of this business aspect in the supplement, either as a measure or as an component.

**ANNEX 3****SUPPORTING MATERIAL – FPI SCORES****Purse Seine Fleet – Ecuador**

<https://www.dropbox.com/sh/t5r0jywp9u3xmb7/AADTngDHEIbFAj4iOk3zAuSha?dl=0>

**Purse Seine Fleet – Mexico**

<https://www.dropbox.com/sh/hoj71kty2ehceb/AAAAGQUi9ZFEadtrqDkdAlcaa?dl=0>

**Longline Fleet – China, China Taipei, Japan & Korea**

<https://www.dropbox.com/sh/avftcec4cgvpuf/AAD3d9qy2NLGiI76bJUGsBEga?dl=0>

**Purse Seine Fleet – Colombia**

[https://www.dropbox.com/sh/01j1h6cy6l9kmsf/AAA3Kz8JfyoN5\\_cnQ8UZf7Una?dl=0](https://www.dropbox.com/sh/01j1h6cy6l9kmsf/AAA3Kz8JfyoN5_cnQ8UZf7Una?dl=0)

**Purse Seine Fleet – Panama**

<https://www.dropbox.com/sh/shkl9af8cd8d81c/AAABU9pQCWkv5UDoxOWsR4DKa?dl=0>

**FPI Supplement – Access Payments – Ecuador & Colombia**

<https://www.dropbox.com/sh/348mvivgdf2xsc5/AAAtB4IOMsJmRnME55vMPKqWa?dl=0>