Executive Summary:
Alternatives to Address Excess Capacity in the Eastern Pacific Purse Seine Tuna Fishery

Revised Final Report

May 2018

Northern Economics

Anchorage
880 H Street
Suite 210
Anchorage, Alaska 99501
Phone: 907.274.5600
Fax: 907.274.5601

Seattle
1455 NW Leary Way
Suite 400
Seattle, WA 98107
Phone: 206.747.8475

Email: mail@norecon.com

This report was prepared for the World Wildlife Fund Inc. (WWF-US) under a grant from the World Bank's Ocean Partnerships for Sustainable Fisheries and Biodiversity Conservation-Models for Innovation and Reform. The technical director is Dr. Vishwanie Maharaj, Lead Economist, Oceans, WWF-US.

PROFESSIONAL CONSULTING SERVICES IN APPLIED ECONOMICS AND SOCIAL SCIENCES

Principals:
Patrick Burden, M.S. – Chairman
Marcus L. Hartley, M.S. – President
Michael Fisher, MBA – Principal
Diane Sauer – Office Manager

Consultants:
Logan Blair, M.S.
Leah Cuyno, Ph.D.
Michael Downs, Ph.D.
Gary Eaton, M.S.
Michelle Humphrey, M.S.
Don Schug, Ph.D.
Katharine Wellman, Ph.D.

Administrative Staff:
Terri McCoy, B.A. – Editor

Northern Economics

880 H Street, Suite 210
Anchorage, Alaska 99501
Phone: 907.274-5600
Fax: 907.274-5601

1455 NW Leary Way, Suite 400
Seattle, WA 98107
Phone: 206.747.8475
Email: mail@norecon.com

Preparers

Team Member	Project Role
Marcus Hartley	Project Manager & Principal Investigator
Dr. Donald Schug	Senior Analyst
Dr. Santiago Bucaram	Economist
Terri McCoy	Editor

Contents

Abbreviations

ACL	annual catch limits
BET	bigeye tuna
BTSD	between trip shore days
CPC	A collective term representing member countries of the IATTC
DAS	days at sea
DEL	dolphin set
DML	dolphin mortality limit
EM	electronic monitoring
EPO	Eastern Pacific Ocean
FAD	fish aggregating device
IVQ	individual vessel quota
IATTC	Inter-American Tropical Tuna Commission
IBSM	Interactive Buyback Spreadsheet Model
m^3	cubic meters
mt	metric tons
NEI	Northern Economics, Inc.
NFO	National Fishery Organization
NOA	unassociated tuna set
NOR	net operating revenues
OBJ	floating object set
PVFE	present value of future earnings
SKJ	skipjack tuna
SMOD	sustainable maximum operating days
SQ	status quo
STVL	Small Tuna Vessel Limit
WWF-US	World Wildlife Fund-US
YFT	yellowfin tuna

ES-1 Document Overview

This document provides an executive summary of technical analyses conducted by Northern Economics, Inc. (NEI) on the methods and alternative means to manage purse seine fleet capacity in the tropical tuna fishery of the Eastern Pacific Ocean (EPO). The substantial growth of fishing capacity of the tuna purse seine fleet operating in the EPO in the last two decades has led to a current fleet capacity that is considerably in excess of the target level 158,000 cubic meters (m^3) of well volume adopted by the Inter-American Tropical Commission (IATTC) in August 2000. In 2016 the total operative capacity was 264,859 m^3 and potential total capacity was 296,415 m^3.

This consultancy is funded under the Eastern Pacific component of the World Bank's Global Environment Facility's Areas beyond National Jurisdiction Ocean Partnerships for Sustainable Fisheries and Biodiversity Conservation Program, with the World Wildlife Fund as the Executing Agency.

The full report is organized into four chapters:

Chapter 1 is an introduction that provides background information and report organization.

Chapter 2 contains a summary of existing conditions in the EPO purse seine fishery.

Chapter 3 provides a quantitative assessment of the cost of over-capacity under the status quo.

Chapter 4 provides both qualitative and quantitative assessments of potential ways to address or begin to address overcapacity in the EPO purse seine fishery.

ES-1.1 Final Suite of Alternatives for Analysis

A total of eight capacity reduction programs and initiatives are assessed in the report—three are assessed qualitatively and five quantitatively. The **qualitatively** addressed programs include the following:

1) Whenever there is a request to reassign capacity, additional capacity must be removed;
2) A "Small Steps" initiative sets the stage for additional actions to reduce capacity;
3) Freeze current latent capacity on the vessel register until fleet capacity reaches the optimum.

The five capacity reduction programs the NEI Team assesses **quantitatively** are as follows:

4) A Vessel/Capacity Buyback Program;
5) IATTC Member States (CPCs) Reduce Operative Capacity by 10 Percent per Year and Freeze that Capacity until total Capacity reaches the optimum level;
6) Voluntary Capacity Reduction Pilot Programs;
7) A Transferable Individual Vessel Quota Program;
8) Annual Small Tuna Vessel Limits for Bigeye (BET) and Yellowfin (YFT).

ES-2 Highlights and Findings from Chapter 2: Existing Conditions

This section of the Executive Summary contains highlights and findings with respect to existing conditions in the EPO purse seine fishery.

ES-2.1 Capacity Management in the EPO Purse Seine Fishery

Since 2002, the primary means of management of the purse seine fishery has been through the limitation of capacity. This was accomplished under Resolution C-02-03, which set a target capacity level of 158,000 m^3 of vessel hold space, and created the Vessel Register as the definitive list of purse seine vessels authorized to fish for tuna in the EPO.

The IATTC defines the following six types of capacity, noting that the definitions are adapted directly from the glossary of terms in IATTC Document CAP-18-03.

1) **Available Capacity** is the total well volume (m^3) that a CPC has available for future allocation to vessels as a result of: (a) vessels being removed from the Register; (b) vessel reflagging; (c) non-allocated residuals from transfers on the Register; Available Capacity rose from ≈ 20,000 m^3 in 2002, to over 60,000 m^3 from 2009 to 2013, then fell to ≈ 20,000 m^3 in 2015. (d) the national capacity allocations specified in paragraph 10 of Resolution C-02-03.

2) **Inactive/sunk capacity** is the capacity of (a) vessels that are on the Register and have declared that they will not fish during a given year, or (b) vessels that have sunk. Inactive capacity has declined from ≈ 40,000 m^3 in 2002 to < 10,000 m^3 in 2017.

3) **Operative capacity** is the total well volume (m^3) of all vessels which fished for tuna in the EPO in that year. The NEI Team notes that Operative Capacity increased by ≈ 50,000 m^3 from 2014 to 2016 after holding fairly steady between 200,000 and 225,000 m^3 since 2002. The increase corresponds to the reductions in “Available Capacity” in those same years.

4) **Authorized Capacity** is total well volume (m^3) of vessels that are on the IATTC Regional Register and are authorized to fish in the EPO. Authorized capacity has increased from ≈ 220,000 m^3 in 2002 to over 280,000 m^3 in 2017.

5) **Potential Total Capacity** is the sum of authorized capacity, inactive/sunk capacity, and available capacity over time—i.e. the capacity could be operating if all CPCs activated all their vessels and used all their available capacity including inactive/sunk capacity to bring new vessels into the fishery. Potential Total Capacity has increased from ≈ 270,000 m^3 to ≈ 305,000 m^3 in 2017.

ES-2.2 Vessel Types and Set Types Summarized in this Analysis

The IATTC harvest data categorizes purse seine fishing activity using three types of purse seine sets:

- **FAD Sets (OBJ sets)**: sets that are made on/around Fish Aggregating Devises (FADs). The majority of OBJ sets occur within 10 degrees of the equator.
- **Dolphin Sets (DEL sets)**: sets that are made around schools of dolphins under a Dolphin Mortality Limit (DML). Most DEL sets occur north of the equator up to about 20° N.
- **Unassociated Sets (NOA sets)**: sets that are not directly associated with FADs or dolphins; most occur in close proximity to land masses south of the equator.

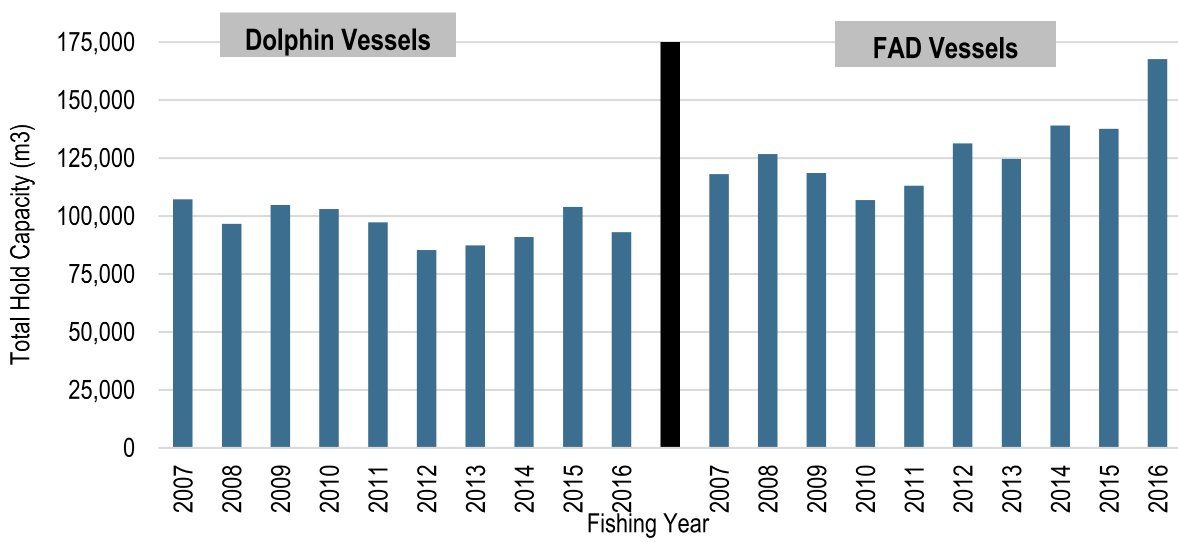
All operative vessels are categorized in this report as either FAD vessels or Dolphin vessels based on their predominant set type. The distinction between FAD vessels and Dolphin vessels is a major topic throughout this report because of the differences in operating characteristics, primary harvest species, and principal countries of origin. A third category of vessels (Latent vessels) is also defined.

- **Dolphin vessels** are vessels that make 50 percent or more of their sets on dolphins. From 2007 to 2016, an average of 75 Dolphin vessels were operative with the majority based in Mexico.
- **FAD vessels** make 50 percent or more of their sets as OBJ or as NOA Sets. From 2007 to 2016 there have been an average of 141 FAD vessels, with Ecuador comprising a large majority.

The NEI Team notes that the data provided by the IATTC for this analysis were encrypted to protect the identities of vessel owners and individual countries. Therefore, flag countries are reported sparingly.

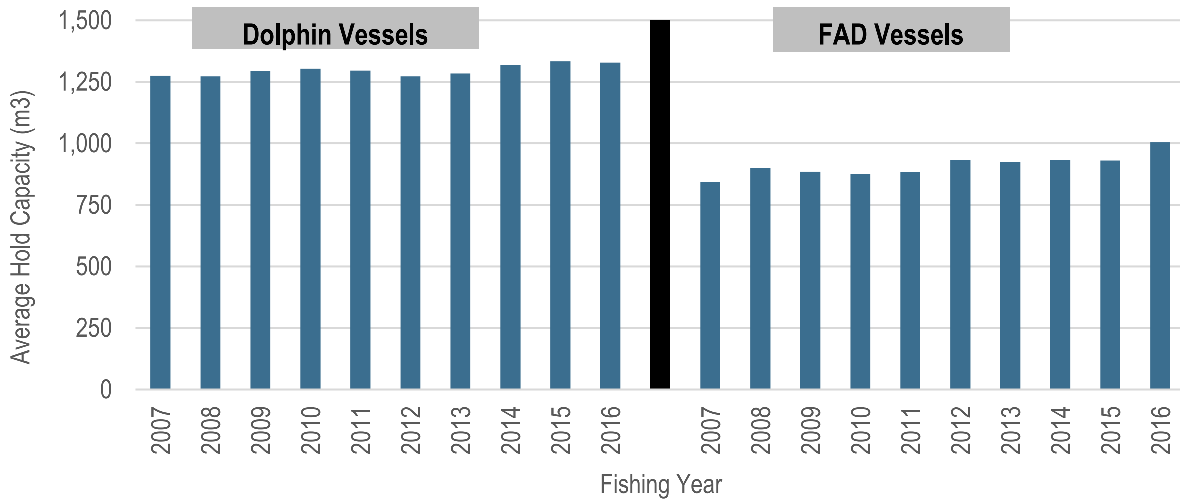
Figure ES-1 shows the total capacity of Dolphin vessels and FAD vessels by year from 2007 to 2016 and Figure ES-2 shows the average capacity per vessel by type over time. Total capacity of FAD vessels has clearly grown over time, particularly since 2010, while total capacity of Dolphin vessels is generally less since 2012 than before. The average capacity of Dolphin vessels is much larger than the average capacity of FAD vessels. During the period shown, Dolphin vessels have had an average capacity of 1,298 m^3, while FAD vessels average 911 m^3.

Figure ES-1. Total Operative Capacity of Dolphin Vessels and FAD Vessels



Source: Developed by Northern Economics using IATTC data.

Figure ES-2. Average Operational Capacity of Dolphin and FAD Vessels

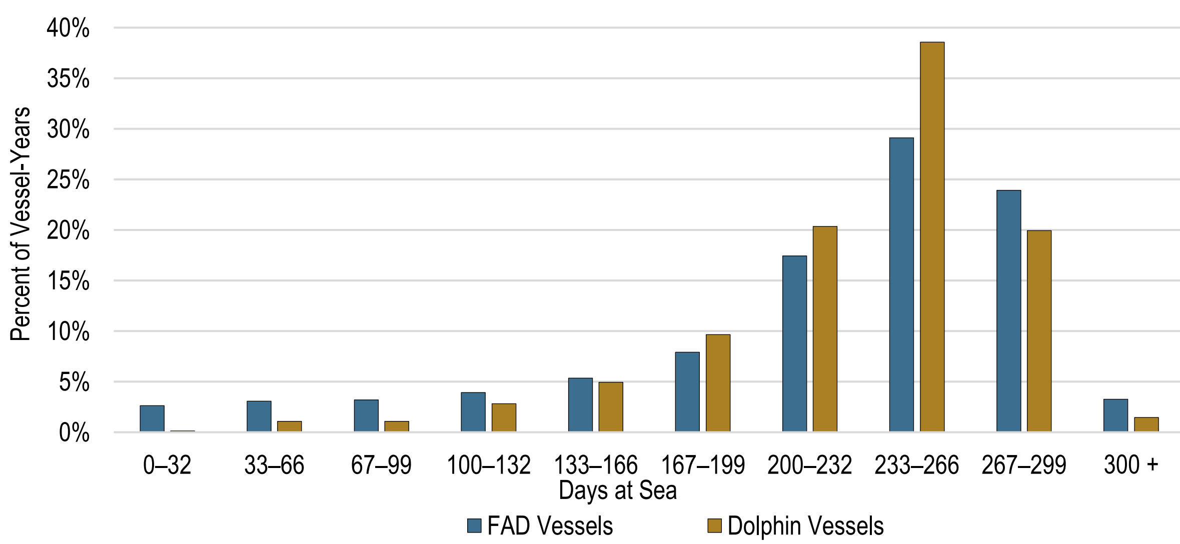


Source: Developed by Northern Economics using IATTC data.

ES-2.3 Vessel Operating Characteristics

Figure ES-3 summarizes the distribution of annual days at sea (DAS) by vessel type from 2007 to 2016. For both vessel types, the peak of the distribution is between 233 and 266 DAS per year—39 percent of Dolphin vessels fall within this bin, as do 29 percent of FAD vessels. A total of 18 percent of FAD vessels and 10 percent of Dolphin vessels had 200 or fewer annual DAS. The NEI team presumes that vessels with fewer than 200 DAS are unlikely to be negatively impacted by the closure periods—vessels with 200 or fewer DAS could most likely have made an additional trip. The NEI Team also notes that vessels at the other end of the spectrum (i.e., with 267 days or more) might not be able to take full advantage of a reduction in closure days.

Figure ES-3. Distribution of Annual DAS by Vessel Type, 2007–2016



Source: Developed by Northern Economics using IATTC data.

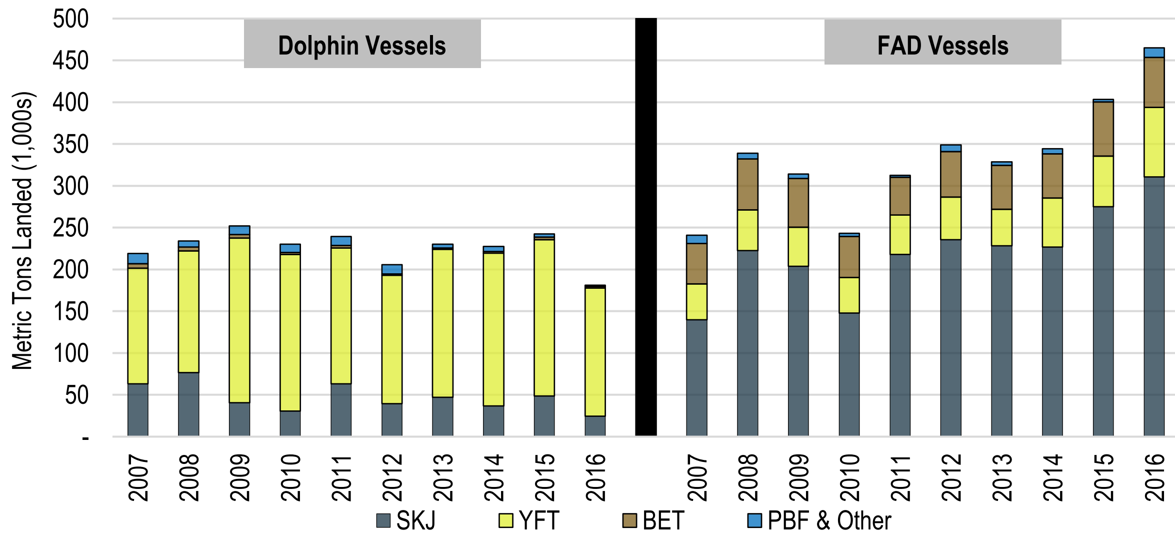
ES-2.4 Harvests, Costs, and Net Operating Revenues by Vessel Type

This section of the Executive Summary describes the harvests, fishing cost and net operating revenues by vessel type from 2007 to 2016.

Figure ES-4 compares EPO tuna harvests of Dolphin vessels to harvests of FAD vessels. Total harvests of Dolphin vessels had been relatively stable through 2015, ranging between 200,000 metric tons (mt) and 250,000 mt, but experienced a significant decline in 2016. Total harvests of FAD vessels have steadily increased over the same period from 241,000 mt in 2007 to 465,000 mt in 2016—this represents an annual growth rate of 6.7 percent. For FAD vessels, the annual growth of skipjack tuna (SKJ) harvests has averaged 8.3 percent, while the annual average growth of YFT and BET harvests were 6.8 percent and 2.5 percent respectively. FAD vessel harvest increases are strongly correlated with overall increases in numbers of sets.

Figure ES-4 demonstrates the difference in species mix between the two vessel types. YFT accounts for an average of 74 percent of the Dolphin vessels total with SKJ at 20 percent and BET at only 1 percent. For FAD vessels, SKJ accounts for 66 percent of the total while YFT and BET account for 16 and 16 percent respectively. From 2007 to 2016, the average Dolphin vessel has landed 3,036 mt per year while the average FAD vessel has landed 2,364 mt per year.

Figure ES-4. EPO Purse Seine Tuna Landings by Species and Vessel Type, 2007–2016

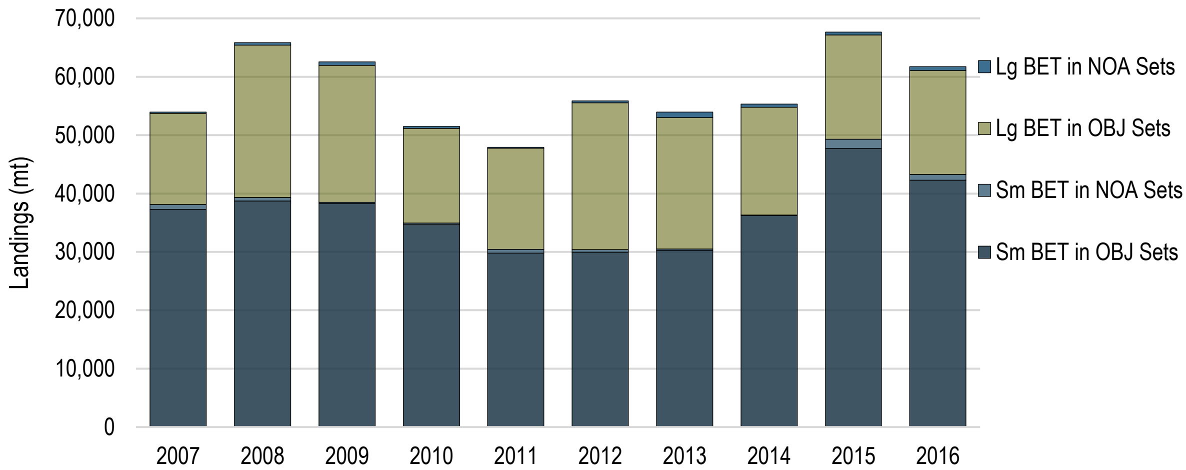


Source: Developed by Northern Economics using IATTC data.

IATTC staff indicated that one of the key factors of sustainable stock management is the determination of harvests between large and small fish and limitations on harvests of small fish. In general, BET tuna are caught only in OBJ and NOA sets—thus, Dolphin vessels as shown in the figure above have very low harvests of BET, while FAD vessels have higher levels of BET.

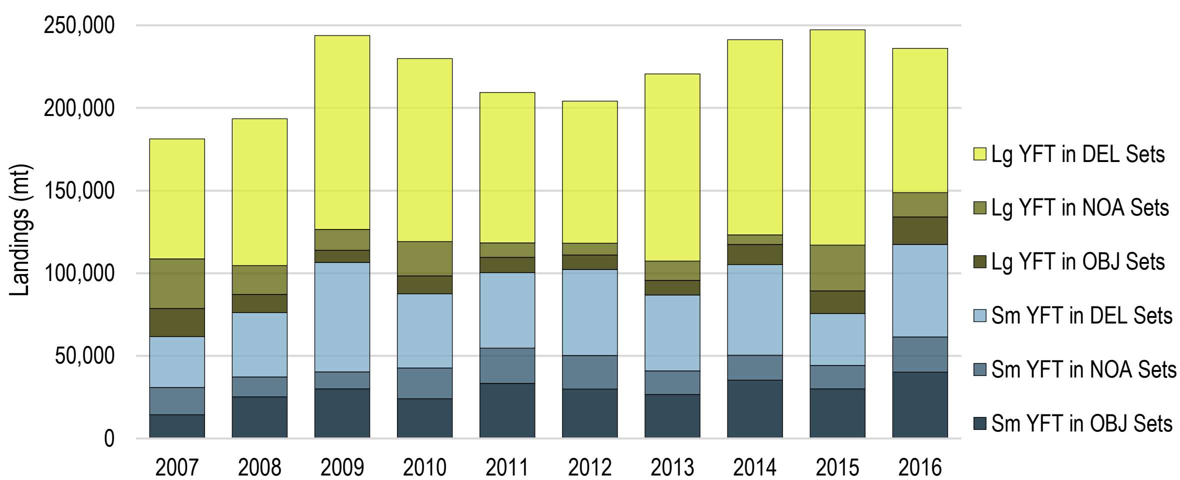
Figure ES-5 shows the harvests of small and large BET by set type from 2007 to 2016 while Figure ES-6 summarizes harvests of small and large YFT. The NEI Team defines large BET and YFT as fish weighing 15 kg or more, while small BET and small YFT are defined as fish weighing less than 15 kg. Evidence from scientific reports of sexual maturity also indicate that 15 kg is a reasonable dividing line between fish that are sexually mature and fish that are more likely to be sexually immature. The majority of BET harvested are small, but by far the largest component of YFT landings are Large YFT in DEL sets. DEL sets also account for the largest amounts of small YFT. From 2007 to 2016, 51 percent of all small YFT were taken in DEL sets, while OBJ sets took 31 percent, and NOA sets accounted for 18 percent.

Figure ES-5. Annual Harvests of Small and Large Bigeye Tuna by Set Type, 2007–2016



Source: Developed by Northern Economics using IATTC data.

Figure ES-6. Annual Harvests of Small and Large Yellowfin Tuna by Set Type, 2007–2016

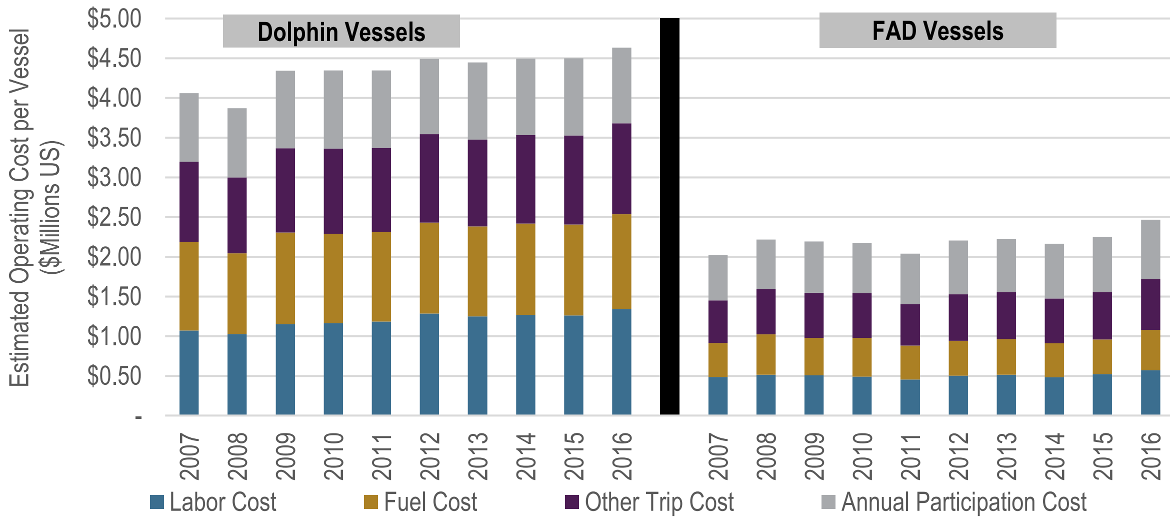


Source: Developed by Northern Economics using IATTC data.

The NEI Team obtained financial data from 22 purse-seine boats that belong to Ecuador (11 boats), Mexico (10 boats) and Panama (1 boat). These representative cost data were used to develop cost profiles for all vessels. Figure ES-7 summarizes estimated annual operating cost by vessel type. Average annual operating costs of Dolphin vessels are estimated to be 98 percent higher than operating costs of FAD vessels. The cost estimates from Figure ES-7 have been presented to members of the industry in Mexico and Ecuador and there was agreement that these cost differentials and are not unreasonable. There are several factors that explain why Dolphin vessels' operating costs are higher than FAD Vessels':

- The majority of FAD Vessels are from Ecuador, where there is a fuel subsidy
- Dolphin Vessels are larger than FAD Vessels, and costs increase with capacity
- Dolphin Vessels operate for more DAS/year than FAD Vessels, and costs increase with DAS.

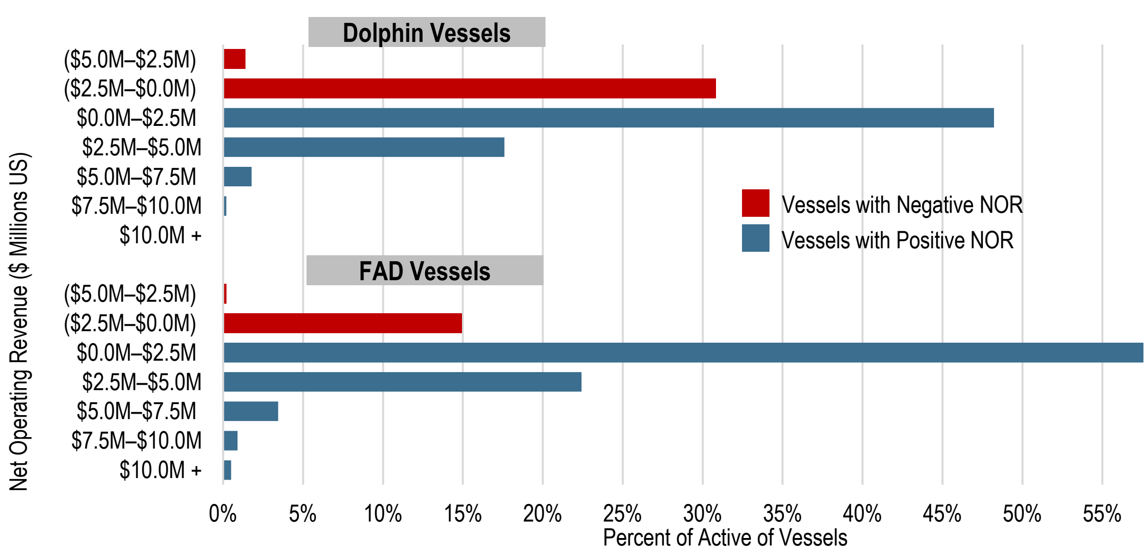
Figure ES-7. Estimated Operating Cost per Vessel by Vessel Type, 2007–2016



Source: Developed by Northern Economics using IATTC data.

Net operating revenues (NOR) are calculated by subtracting operating costs from gross revenues. NOR is a first order estimate of profit; however, it is important to note that the NEI team has not included estimates of debt service or taxes within estimates of operating costs. Figure ES-8 summarizes the distribution of NOR from 2010 to 2016 by vessel type. In this figure, the bars sum up to 100 percent of the vessel-years for each vessel type. During this seven-year period there were an average of 72.3 operative Dolphin vessels, and thus 506 Dolphin vessel years (72.3 × 7 = 506). Similarly, there were an average of 141.4 FAD vessels for a total of 990 vessel-years (141.4 × 7 = 990). The NEI Team estimates that 32 percent of all Dolphin vessel years and 15 percent of FAD vessel years generated losses (shown as red bars). Over 48 percent of Dolphin vessel years and nearly 58 percent of FAD vessel years generate positive NOR between $0 and $2.5 million.

Figure ES-8. Distribution of Estimated NOR, 2010–2016 for Dolphin vessels and for FAD vessels



Source: Developed by Northern Economics using IATTC data.

ES-3 Summary of Chapter 3: Assessment of Costs of Overcapacity

In this chapter, the NEI Team examines the monetary cost of excess capacity in the EPO purse seine fishery. Overcapacity in the EPO purse seine fleet has led the IATTC to enact closure periods in the fishery. First implemented in 2002, the closure periods were extended in 2018 from 62 days for all Class 5 or 6 vessels to 72 days.

The NEI Team notes that in addition to monetary costs, there are other negative consequences of excess capacity including: 1) reductions in stock sizes and effects on catch rates; 2) impacts on processors and processing employees, and 3) impacts on fees charged by CPCs for each unit of capacity.

The monetary costs of excess capacity are quantified from three perspectives:

1) What is the estimated monetary cost, in terms net operating revenues, of the 72-day closure?
2) What has been the cost, in terms net operating revenues, of the 62-day closure?
3) What is the cost of excess capacity in terms of additional closure days that would be required to keep total harvests of BET and YFT at historical levels under a potential situation in which all vessels expand their operations to sustainable maximum levels of effort and efficiency?

The key component of this assessment is an evaluation of each vessel's operations in terms of operating days, and the determination of whether it is operating at hypothetical **sustainable maximum operating days** (SMOD). Vessels that are operating at or near their SMOD are likely experiencing costs of overcapacity. Vessels operating at levels well below their SMOD are unlikely to experience these costs.

Estimated impacts of closure periods are shown in Table ES-1. From 2010 to 2016, the fleet-wide NOR averaged $310 million. The NEI team estimates that the 62-day closure reduced fleet-wide NOR by an annual average of $37 million—an 11 percent reduction. If 72-day closures had been imposed during the same years, negative NOR impacts would have increased to $47 million, a 14 percent reduction.

Table ES-1. Estimated Impact of Closure Periods on Fleet-wide Net Operating Revenues, 2010–2016

	2010	2011	2012	2013	2014	2015	2016	Average
	Revenue in $Millions of U.S. Dollars							
NOR Under Status Quo (SQ)	$141.50	$314.25	$507.77	$524.77	$249.82	$135.20	$297.90	$310.17
Estimated NOR if there were No Closures	$172.73	$358.02	$555.91	$572.47	$284.29	$159.50	$324.67	$346.80
Impact on NOR of the 62-day closures	($31.23)	($43.76)	($48.14)	($47.70)	($34.47)	($24.30)	($26.76)	($36.62)
Expected NOR if Closures were 72 Days	$134.76	$306.60	$495.70	$506.63	$243.09	$125.48	$286.06	$299.76
Impact on NOR of the 72-day closures	($37.97)	($51.42)	($60.20)	($65.84)	($41.20)	($34.01)	($38.61)	($47.04)

It is important to state that these estimates are the product of a series of important and relatively conservative assumptions about vessel behaviors, including:

- All vessels undertake a 30-day maintenance period every year.
- Vessels continue to take trips of the same length as in the past, with the same numbers of between trip shore days (BTSD).
- Vessels do not take marginal/short trips at the end of the year.

As a second approach to assessing the costs of excess capacity, the NEI Team has estimated the number of closure days that would be required if all vessels currently operational in the EPO increased their effective effort to SMOD.

Table ES-2 summarizes landings under the SQ and unconstrained landings during those same years if all vessels are operating at their SMOD. Overall, the NEI Team estimates that harvests could increase by approximately 31 percent over the status quo with some variation by species if not constrained by longer closure periods. The last row of the table shows the estimated closure periods if BET harvests or alternatively YFT harvests are used to calculate the closure period. The maximized fleet would need 84-day closure to keep BET harvests at 2016 levels, or a 90-day closure to keep YFT harvests at 2016 levels.

Table ES-2. Landings by Species under the Status Quo, and if all Vessels are Optimized with No Closure Period

	2010	2011	2012	2013	2014	2015	2016
	Fleet-wide Catch(MT) Under the Status Quo						
All Species	473,604	552,066	554,714	558,591	571,969	646,159	646,344
	Fleet-wide Catch(MT) if All Vessels Operated at Sustainable Maximum Level						
All Species	596,348	704,919	689,449	672,891	733,677	813,234	843,282
	Closure Days Required to Bring Harvests Down to Status Quo Levels						
Use BET daily catch rates to determine closures	97	103	90	92	102	88	84
Use YFT daily catch rates to determine closures	95	91	85	84	100	87	90

ES-4 Summary of Chapter 4: Capacity Management Alternatives

A total of eight alternative programs to manage capacity in the EPO purse seine fishery are examined. Three are examined qualitatively and five are addressed quantitatively.

ES-4.1 Qualitative Assessment of Three Programs to Reduce Capacity in the EPO Purse Seine Fishery

ES-4.1.1 Remove Capacity from the Vessel Register whenever there is a Request to Reassign Capacity

The Japanese delegation submitted Prop-H-2-JPN to the IATTC in 2013. Specifically:

1) A second-hand replacement vessel can use only 90 percent of the replaced vessel's capacity;
2) A new replacement vessel can use only 80 percent of the replaced vessel's capacity;
3) If activating inactive/available capacity, the new capacity cannot exceed 95 percent of the inactive/available capacity used.

Using historical data on replacement vessels in the Register, the assessment develops estimates of the number need to reach the target capacity level of 158,000 m^3. In addition, the NEI Team calculates the number of replacements per year that would be required to reach reduction goals in 25 years.

As of November 2017, the Register listed 283,805 m^3 of vessel capacity. Reducing capacity to 158,000 m^3 will require a reduction of 125,805 m^3. Based on IATTC data, there are an average of 8 vessel replacements/year, with an estimated annual average replaced capacity of 8,378 m^3. Using the reduction formula above, 1,096 m^3/year would be removed yearly, and it would take 115 years to attain the 158,000

m^3 goal. To reach the 158,000 m^3 goal in 25 years, annual replacements would need to increase to 45.9 vessels/year.

The IATTC could consider modifications to the Japanese proposal to reach the IATTC optimum (158,000 m3) in less time at the same average capacity replacement of 8,378 m^3 per year (Table 17 in the full report). For example, if the percentage of capacity to retire with each replacement is 40% for both new and used vessels, it is possible to reach the IATTC optimum of 158,000 m^3 in 23 years. Please note that such a provision could also have the effect of reducing the rate of vessel replacement.

ES-4.1.2 Multiple Small Measures that could Be Adopted in Association with Other Programs

This “program” comprises a series of small steps that may be easy to implement. Several of the small steps are precursors to other policy changes that could result in larger capacity reductions.

The first three small steps are directly related to capacity issues, while the final four measures could help facilitate more significant management measures in the future:

- Add a requirement that before countries replace lost vessels with newly-built vessels, they must document that existing vessels are unavailable
    - There have been 29 sinkings from 2000 to 2017. This requirement could slow down the replacement of vessels that have been lost and could potentially slow the technological expansion of capacity.
- Add a requirement that U.S. vessels that are not on the IATTC register must provide to IATTC staff an application to use their exemption prior to the beginning of the fishing year.
    - The notification could provide IATTC staff with additional information; however, it is likely that all vessels will file a notification every year to maintain their option to participate in the EPO.
- Tighten the rules regarding claims of hardship vis-à-vis the closure because of force majeure;
    - The NEI Team recommends these potential changes:
        - Require the IATTC Director to indicate whether the vessel has used an exemption before.
        - Tighten *Force Majeure* definitions by: 1) stating that exemptions are not allowed if vessel owners do not follow standard protocols for vessel maintenance; and 2) require documentation of shipyard maintenance within 400 days of a *Force Majeure* event.
- Tighten definitions of set types with particular attention to definitions of NOA sets and OBJ sets;
    - The NEI Team recommends a definition for NOA sets that requires a minimum and measurable distance (e.g. 500 meters) between the vessel and any floating object.
- Require vessels that set on FADs to provide the documentation to the IATTC of all FADs.
    - These data would be a valuable tool to enhance assessment of the impact of FADs.
- Implement a reduced form of an electronic monitoring (EM) system;
    - A reduced form of EM would help with new set type definitions and could improve monitoring discards under an individual vessel quota (IVQ) program, or any other program that creates an incentive for discards.
- Make changes to the onboard observer program to align with other changes;
    - If the IATTC wishes to move to a system that limits total catch on a species-by-species basis, then observers become important deterrents against misreporting.

- Enhance the shore-side plant inspectors so every offload is monitored with timely reporting;
    - If the IATTC implements programs that limit harvests of individual vessels (e.g. IVQs), the plant inspector program is the best candidate to morph into an enhanced monitoring system.

ES-4.1.3 Freeze Current Latent Capacity on the Register until Fleet Capacity is Reduced

This option would freeze latent capacity on the Register until optimal capacity is attained. There are three types of "latent" capacity: 1) "inactive" vessels; 2) "sunk" vessels; and 3) vessels listed in the Register but which are not actively fishing. For purposes of this analysis, the NEI Team will call these vessels "Authorized/Latent" vessels. There are also other types of latent capacity:

- Vessels that were deemed "unconstrained" in the assessment of the cost of overcapacity—these vessels could increase the intensity of their operations leading to more closure days.
- U.S. flagged vessels authorized to take one 90-day trip each year. There are currently 21 such vessels with a total capacity of 33,337 m^3, with an effective capacity of 8,334 m^3.

Table ES-3 provides a comparison of potential capacity to the actual fishery data for 2016. The operating capacity in 2016 was 23,132 m^3 less than the authorized capacity in the Register.

Table ES-3. Current Purse Seine Register Status with a Comparison to Operating Capacity in 2016

Current Register Status	Vessel Count	Hold Capacity (m^3)
Current Inactive/Sunk Capacity	13	5,697
Eligible U.S, "paragraph 12" vessels	21	8,334
Current Authorized Capacity in the IATTC Register	271	283,805
Current Register and "Paragraph 12" Total	**305**	**297,836**
2016 Actual Operative Capacity (includes 2 active paragraph 12 vessels)	237	260,673
Current Register and 'Paragraph 12" Total in Excess of 2016 Actual Operating Capacity		37,163

Source: Developed by Northern Economics, Inc. based on data provided by IATTC.

There is no doubt that freezing officially latent capacity on the Register will be a benefit to vessels that are currently operative. However, allowing these vessels to become operative after capacity has been reduced appears to be counterproductive.

ES-4.2 Quantitative Assessment of Programs to Reduce EPO Purse Seine Capacity

Five capacity reduction programs are examined quantitatively:

1) A Vessel Buyback Program;
2) A Gradual Phased-in Capacity Reduction Program;
3) Short-term Country-Specific Buyback Pilot Programs;
4) Annual Small Tuna Vessel Limits for Bigeye (BET) and Yellowfin (YFT); and
5) An Individual Vessel Quota Program.

ES-4.2.1 A Vessel Buyback Program

The examination of a Vessel Buyback Program focuses on fleetwide costs and closure days resulting from permanent removal of capacity from the Register via purchase by a sanctioned Buyback Authority.

For purposes of this assessment, the NEI Team presumes that the program will operate as follows:

1) A Buyback Authority will be established.
2) Funding will be secured by the Buyback Authority as some combination of loans and grants.
3) The Buyback Authority will publish rules under which bids will be accepted and the protocols/criteria by which bids be judged and awarded—specifically bids will be ranked in a reverse auction with lower bids accepted before higher bids until funding has been allocated.
4) Vessel owners working with their National Fishery Organizations (NFOs) will determine the amount they would accept to permanently remove the capacity from the Register; noting that the vessel itself would be permanently banned from participating in the EPO.
5) Vessel owners with NFO agreements will submit binding bids to the Buyback Authority.
6) The Buyback Authority will rank and sort the bids and notify winning bid and post the result of the process with the total cost of the buyback, the debt service, and estimated annual payments.
7) The NEI Team presumes that the owners of each active vessel remaining in the fishery will be required to pay an annually calculated percentage of their vessel's total revenue.
8) Remaining vessel owners will formally bind themselves to repay the vessel buyback loan.
9) The Buyback Authority will secure the loan, pay winning bidders and permanently remove capacity from the IATTC Register.
10) No further claims for additional capacity to be added to the Register will be considered.

The analysis of the buyback program examines eight levels of capacity reduction as follows:

1. Reduce capacity to be ≤ 263,805 m^3
2. Reduce capacity to be ≤ 243,805 m^3
3. Reduce capacity to be ≤ 223,805 m^3
4. Reduce capacity to be ≤ 203,805 m^3
5. Reduce capacity to be ≤ 183,805 m^3
6. Reduce capacity to be ≤ 171,000 m^3 (i.e. the "Optimal Fleet" as estimated by Squires)
7. Reduce capacity to be ≤ 158,000 m^3 (i.e. the "Optimal Fleet" as estimated by IATTC)
8. Reduce capacity by the minimum amount that will eliminate closure days

For each of the eight capacity reduction levels, there are six scenarios that differ in the way that bid amounts are ranked, and in the bid levels assumed for relatively unprofitable or latent vessels.

For relatively profitable vessels, the bid amounts are assumed to be the **P**resent **V**alue of the **F**uture **E**arnings (PVFE) of the vessel as estimated by the NEI Team based on Average Net Operating Revenues (NOR) for each vessel from 2010 to 2016 (see Figure ES-8).

The NEI Team has no real basis for quantifying estimated bid values of latent vessels, or for vessels which were estimated to have generated negative PVFEs. Therefore, the NEI Team assumes six alternative minimum amount and bid-ranking scenarios as follows:

- Scenario 1: Buyback with a minimum bid of $1 million and ranked by lowest bid per m^3 of capacity
- Scenario 2: Buyback with a minimum bid of $2 million and ranked by lowest bid per m^3 of capacity
- Scenario 3: Buyback with a minimum bid of $3 million and ranked by lowest bid per m^3 of capacity
- Scenario 4: Buyback with minimum bids scaled by vessel size and ranked by lowest bid per m^3 of capacity—minimum bids are assumed to be ≈ $2,207 per m^3.
- Scenario 5: Buyback with scaled minimum bids weighted by days at sea percentages
- Scenario 6: Buyback with scaled minimum weighted inversely by days at sea percentages

There are 48 buyback options assessed. In addition, there are thousands of variations in the way that the buyback can be funded. Funding variations include the terms of the buyback loan (i.e. length of repayment period and the interest rate) and the amount of grant funding. The NEI Team assumes as a default that there is no grant funding and the buyback loan has a 20 year-term at 10 percent/year.

To capture the huge range of potential funding options for the buyback program, the NEI Team has also developed an Interactive Buyback Spreadsheet Model (IBSM). The IBSM includes results for all 48 of the different options. In addition, the IBSM allows users to specify a wide range of different financing options for the buyback, including years for repayment (5 to 40 years), the interest rate (2 to 22 percent) and a grant amount that could offset some or all, of the buyback loan. Appendix C in the main report contains detailed tables for each of the 48 distinct buyback options.

The summary results provided here show projected outcomes under all six scenarios for two buybacks which differ in the amount of capacity removed. Included are a buyback that removes 80,000 m^3 of capacity and a buyback that removes capacity to levels at which closure days can be eliminated.

Summary results for a buyback that removes 80,000 m^3 of capacity

- Reduces closure days to an average across all scenarios of 23 days (Row 3)
- Has an average total cost across all scenarios of $160.9 million (Row 5)
- Has an average annual fleetwide loan payment across all scenarios of $18.9 million (Row 7)
- The average fee as a percent of future expected revenue across all scenarios is 2.2 percent (Row 9)
- The average fee per m^3 of remaining capacity across all scenarios is $92.9 (Row 10)
- FAD vessels are estimated to gain an average of $177,566 in NOR across all scenarios (Row 11)
- Dolphin vessels are estimated to gain an average of $93,776 in NOR across all scenarios (Row 13)

Table ES-4. Results from Buyback Scenarios that Removes 80,000 m³ of Capacity

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Remove 80,000 m³ of Capacity—Remaining Capacity is ≤ 203,805 m³						
1) Number of Vessels Removed	74	71	55	74	73	56
2) Capacity Remaining (m³)	203,163	203,757	203,538	202,514	203,630	203,524
3) Estimated Post-Buyback Closure Days	29	31	17	29	33	No Closure
Vessel Buyback Impacts Estimated on a Fleetwide Basis						
4) Estimated NOR Gain per Active Vessel Exclusive of Buyback Fees	$205,582	$190,627	$282,814	$209,366	$174,611	386,872
5) Total Vessel Buyback Cost—the Loan Principal Without Interest ($Millions)	$85.52	$126.91	$169.96	$167.58	$199.91	$215.26
6) Cost ($) per m³ of Capacity Removed	$1,060	$1,585	$2,117	$2,061	$2,493	$2,681
7) Total Annual Loan Payment ($Millions)	$10.04	$14.91	$19.96	$19.68	$23.48	$25.28
8) Default Loan Repayment Fee/Vessel	$50,988	$74,534	$102,903	$99,919	$118,592	$135,210
9) Loan Repayment Fee as a Percent of Future Annual Revenue	1.2%	1.8%	2.3%	2.3%	2.7%	3.1%
10) Loan Repayment Fee / Remaining m³	$49.44	$73.16	$98.08	$97.20	$115.31	$124.23
Vessel Buyback Impacts Estimated Specifically for FAD Vessels						
11) NOR Gains / FAD Vessel Net of the Average Buyback Fee (% of Revenue)	$186,156	$143,008	$213,574	$139,681	$96,069	286,910
12) NOR Gains / FAD Vessel Net of the Average Fee paid as Fee per m³	$192,076	$151,351	$230,177	$150,804	$113,834	$306,902
Vessel Buyback Impacts Estimated Specifically for Dolphin Vessels						
13) NOR Gains / Dolphin Vessel Net of the Average Buyback Fee (% of Revenue)	$105,421	$71,843	$121,150	$60,005	($2,188)	$206,428
14) NOR Gains / Dolphin Vessel Net of the Average Fee paid as Fee per m³	$91,904	$51,903	$99,054	$33,989	($36,152)	$182,482

Summary results for a buyback that removes enough capacity to eliminate closure days

- Eliminates closure days across all scenarios (Row 3)
- Has an average total cost across all scenarios of $223 million (Row 5)
- Has an average annual fleetwide loan payment across all scenarios of $26.2 million (Row 7)
- The average fee as a percent of future expected revenue across all scenarios is 3.1 percent (Row 9)
- The average fee per m³ of remaining capacity across all scenarios is $148.1 (Row 10)
- FAD vessels are estimated to gain an average of $307,913 in NOR across all scenarios (Row 11)
- Dolphin vessels are estimated to gain an average of $183,312 in NOR across all scenarios (Row 13)

Table ES-5. Results from Buyback Scenarios that Result in Elimination of Closure Periods

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Remove Enough Capacity to Completely Eliminate Closure Days						
1) Number of Vessels Removed	90	92	88	90	103	46
2) Capacity Remaining (m^3)	179,722	173,187	176,043	179,722	162,842	217,258
3) Estimated Post-Buyback Closure Days	No Closure	No Closure	No Closure	No Closure	No Closure	No Closure
Vessel Buyback Impacts Estimated on a Fleetwide Basis						
4) Estimated NOR Gain per Active Vessel Exclusive of Buyback Fees	$403,509	$408,233	$395,312	$403,509	$423,550	$330,129
5) Total Vessel Buyback Cost—the Loan Principal Without Interest ($Millions)	$148.22	$215.80	$256.60	$229.76	$327.69	$161.91
6) Cost ($) per m^3 of Capacity Removed	$1,424	$1,951	$2,381	$2,207	$2,709	$2,433
7) Total Annual Loan Payment ($Millions)	$17.41	$25.35	$30.14	$26.99	$38.49	$19.02
8) Default Loan Repayment Fee/Vessel	$96,185	$141,610	$164,699	$149,100	$229,107	$96,537
9) Loan Repayment Fee as a Percent of Future Annual Revenue	2.0%	3.0%	3.6%	3.1%	4.6%	2.2%
10) Loan Repayment Fee / Remaining m^3	$96.87	$146.36	$171.21	$150.16	$236.36	$87.54
Vessel Buyback Impacts Estimated Specifically for FAD Vessels						
11) NOR Gains / FAD Vessel Net of the Average Buyback Fee (% of Revenue)	$366,173	$313,488	$281,813	$313,258	$253,338	$319,409
12) NOR Gains / FAD Vessel Net of the Average Fee paid as Fee per m^3	$377,619	$331,021	$301,979	$331,000	$283,519	$333,871
Vessel Buyback Impacts Estimated Specifically for Dolphin Vessels						
13) NOR Gains / Dolphin Vessel Net of the Average Buyback Fee (% of Revenue)	$232,425	$189,729	$157,473	$179,509	$110,496	$230,243
14) NOR Gains / Dolphin Vessel Net of the Average Fee paid as Fee per m^3	$204,031	$144,495	$105,279	$135,494	$35,043	$213,783

ES-4.2.2 All CPCs Commit to Reduce Authorized Capacity by 10 Percent per Year

The 10 Percent per Year Reduction Program <u>assumes</u> the following programmatic guidelines:

1) All countries agree in advance to follow the protocols of the program for a period of five years.
2) All vessels that are listed as **Inactive** or **Sunk** in the IATTC Register will maintain that same status.
3) For purposes of this program …
   a. an **authorized** vessel is a purse seine vessel in the IATTC Register that is neither **Inactive/Sunk**, regardless of whether it landed tuna in the EPO in the most recent year.
   b. an **active** vessel is a vessel that landed tuna from the EPO in the most recent year of fishing.
   c. For purposes of this program, a **latent** vessel is a vessel that is **authorized** with respect to the IATTC Register, but which did not land tuna from the EPO in the most recent year of fishing.
4) The U.S. agrees to prohibit vessels from fishing in the EPO under the exemption in Resolution C-02-03.
5) All countries will participate in the program, but countries with fewer than 10 **authorized** vessels will only remove their **latent** vessels.
6) Removal of vessels will be temporary—the Register vessel's status will be changed to **Inactive.**
7) For purposes of this assessment, Year 0 is the year prior to implementation of the program.

8) Prior to the beginning of Year 1 of the program, the following will occur:
   a. All countries will redesignate <u>all vessels</u> that were **latent** in Year 0 as **Inactive** in the Register.
   b. Any country with 10 or more **active** vessels in Year 0 will redesignate vessels such that the sum of redesignated **latent** and **active** vessels = 10 percent of its **authorized** vessels from Year 0.
   c. By the end of the first quarter, IATTC staff will calculate closure day reduction for Year 1.
9) Prior to the beginning of the next four years, the following will occur:
   a. All countries that had 10+ active vessels will redesignate 10 percent as Inactive.
   b. Countries with fewer than 10 vessels need take no further action.
   c. By the end of the first quarter IATTC staff will calculate closure days reduction for the year.
10) During Year 5, the program could be extended, modified, or eliminated.

With the reductions from Year 4, the NEI Team estimates that the closure period can be eliminated completely, and thus no further reductions would be required in Year 5. By Year 4, a total of 86 vessels will have been redesignated—34 latent vessels and 52 that were active. Authorized capacity in the fleet will have been reduced from 283,805 m^3 in Year 0 to 202,607 m^3 in Year 4. NOR per active vessel is estimated to increase to an average of $1.77 million from $1.06 million in Year 0.

Under the 10-Percent Program, each reduction in authorized capacity results in a greater reduction in closure days than the reductions achieved in the Buyback Program. This difference results because the proportion of FAD and Dolphin vessels that are redesignated is approximately equal. Recall that Dolphin vessels catch only very small amounts BET, while FAD vessels catch BET and YFT in approximately equal proportions. Redesignating Dolphin vessels and FAD vessels in equal proportions leaves the remaining fleet with the same ability to catch both BET and YFT as in the Status Quo.

Under the Buyback Program, relatively more Dolphin vessels were being removed than FAD vessels, which in turn means that the ability of the remaining fleet to catch YFT was decreasing faster than the ability of the remaining fleet to catch BET. The disproportionate removal of Dolphin vessels under the Buyback Program means that even more vessels had to be removed from the fleet to reduce the BET catching power of the remaining fleet to levels that would allow the elimination of the closure periods. This same factor also leads to the much greater increases in the average NOR/vessel estimated under the 10-Percent Program relative to per vessel increases in NOR under the Buyback Program.

One of the key findings of the vessel buyback assessment is that there are differential effects depending on the catch histories of the vessels removed. Thus, the design of the buyback should try to remove proportional levels of catching power for the two key species to meet the IATTC's conservation targets.

ES-4.2.3 Voluntary Single Country Capacity Reduction Pilot Program

These voluntary capacity reduction programs are based on the premise that a flag state with large capacity holdings could voluntarily reduce its capacity enough that its remaining vessels would receive an appropriate reduction in their closure days. These single-country programs would need the approval of the full IATTC to move forward—unilateral capacity reductions would be welcomed, but without approval, CPCs choosing to reduce capacity would not receive exemptions from the closure periods.

For purposes of this analysis, the NEI Team has assumed that both Ecuador and Mexico choose to develop pilot programs for a period of 5 years. It is also assumed that they idle enough capacity that the remainder of their fleets can fish without closure days for the duration of the pilot programs.

In order to protect the confidentiality of individual vessels and specific countries, the NEI team has developed "Pseudo-Fleets" for Ecuador and Mexico. The Pseudo-Ecuador fleet is comprised of similar but slightly higher numbers of vessels with slightly higher levels of total capacity than the actual fleet from

Ecuador. The Pseudo-Ecuador fleet includes 116 vessels with capacity of 96,568 m^3, including 99 Ecuadorian flagged vessels. The Pseudo-Mexico fleet includes 50 vessels with a capacity of 61,925 m^3 including 40 Mexican flagged vessels.

Other key assumptions used in the assessments of these pilot programs are:

- The NFO for each country will manage the programs and will commit to the IATTC that they and their vessels will comply with IATTC stipulations approving the Pilot Programs.
- The NFOs will conduct temporary/annual buyback programs similar to those described for the fleetwide buyback program.

- Table ES-6 and Table ES-7 show the estimated results of the two pilot programs. The differences between the two programs are noteworthy, as are the differences between these two single-country programs and the results of the fleet-wide buyback program as summarized in FAD vessels are estimated to gain an average of $307,913 in NOR across all scenarios (Row 11)
- Dolphin vessels are estimated to gain an average of $183,312 in NOR across all scenarios (Row 13)

Table ES-5. First, the total number of vessels that would be removed for the two pilot programs combined (≈30 vessels) is approximately 35 percent of the number of vessels that would need to be removed under the fleetwide buyback, despite the fact that the two Pseudo-fleets comprise over 65 percent of entire 271-vessel Registered EPO fleet. The reason that so few vessels need to be removed is due primarily to the fact that there are no latent vessels that need to be removed.

Another key finding is seen in the estimated costs of the three programs. If measured in terms of annual repayment fees per m^3 that would be charged to the remaining fleet, the Pseudo-Ecuador fleet would pay $144/$m^3$ under Scenario 3, while the Pseudo-Mexico fleet would pay just $66/$m^3$ under their pilot program. Under the fleetwide buyback, the annual fee per m^3 under Scenario 3 would be $171/$m^3$.

The difference can be attributed to variations in the harvesting patterns between the Pseudo-Ecuador fleet, the Pseudo-Mexico fleet, and the entire EPO fleet as a whole. Dolphin vessels do not catch BET and FAD vessels catch smaller proportions of both BET and YFT (see Figure ES-4 on page ES-8).

Table ES-6. Estimated Results of a Pilot Single-Country Buyback Program for the Pseudo-Ecuador Fleet

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
	$1M Minimum Bid	$2M Minimum Bid	$3M Minimum Bid	Minimum Bid Varies by m^3	Variable Min. & Weight by EPO DAS	Variable Min. & Inverse Weighting
Active Vessels Remaining (from 116)	97	98	97	96	92	98
Capacity (m^3) Remaining (from 96,568)	68,749	66,248	64,742	69,003	67,000	69,576
Annual Pilot Program Cost*	$4,834,014	$7,009,823	$9,311,312	$8,375,398	$12,363,811	$8,257,180
Average Payment per Remaining Vessel	$49,835	$71,529	$95,993	$87,244	$134,389	$84,257
Repayment fee per m3 of remaining capacity	$70.31	$105.81	$143.82	$121.38	$184.53	$118.68
NOR Gains per Vessel Less Average Fee	$325,172	$309,190	$280,824	$297,944	$271,711	$304,978

Note: Estimated pilot program cost include only the compensation paid to vessel owners.

Table ES-7. Estimated Results of a Pilot Single-Country Buyback Program for the Pseudo-Mexico Fleet

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
	$1M Minimum Bid	$2M Minimum Bid	$3M Minimum Bid	Minimum Bid Varies by m³	Variable Min. & Weight by EPO DAS	Variable Min. & Inverse Weighting
Active Vessels Remaining (from 50)	40	41	42	42	41	42
Capacity (m³) Remaining (from 61,925)	48,335	48,155	49,101	49,446	48,727	50,436
Annual Pilot Program Cost*	$1,531,096	$2,544,899	$3,213,091	$3,523,794	$3,878,892	$3,480,848
Average Payment per Remaining Vessel	$38,277	$62,071	$76,502	$83,900	$94,607	$82,877
Repayment fee per m³ of remaining capacity	$31.68	$52.85	$65.44	$71.27	$79.60	$69.02
NOR Gains per Vessel Less Average Fee	$88,956	$43,706	$19,793	$9,825	($553)	$38,930

Note: Estimated pilot program costs include only the compensation paid to vessel owners.

ES-4.2.4 Annual Small Tuna Vessel Limits for BET and YFT

This alternative imposes and implements annual vessel-level limits on harvests of **small** BET and YFT. The intent of the program is to limit the effective capacity of a small number of operators that catch large quantities of small BET and YFT relative to harvests of most of the fleet, and to incentivize vessels to reduce harvests of small tuna. The Small Tuna Vessel Limit (STVL) Program details are as follows:

1) Define small BET and YFT as all fish that are less than 15 kg.
2) The BET and YFT STVLs would be set at levels that would eliminate closure days.
3) Attainment of STVLs at the vessel level would be determined by plant inspector reports.
4) If a vessel reaches its STVL of either species, the vessel must stop fishing for the rest of the year.

The estimated distributions of harvests of small BET and YFT in 2016 with their respective STVLs are shown in Figure ES-9 and Figure ES-10. The estimated STVL for BET is set at 1,083 mt and the STVL for YFT is set at 982 mt. Assuming the STVLs were set at the beginning of the year, affected vessels would need to change their fishing behavior or face an even shorter fishing year than with the 62-day closure.

Figure ES-9. Estimated Catch of Small BET by Vessel in 2016 Augmented with the Assumed STVL for BET

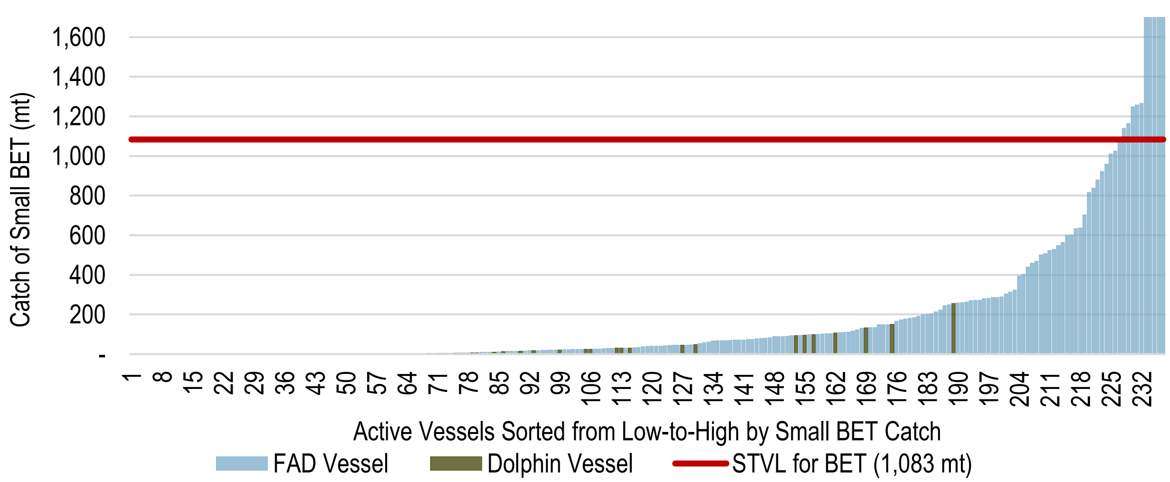
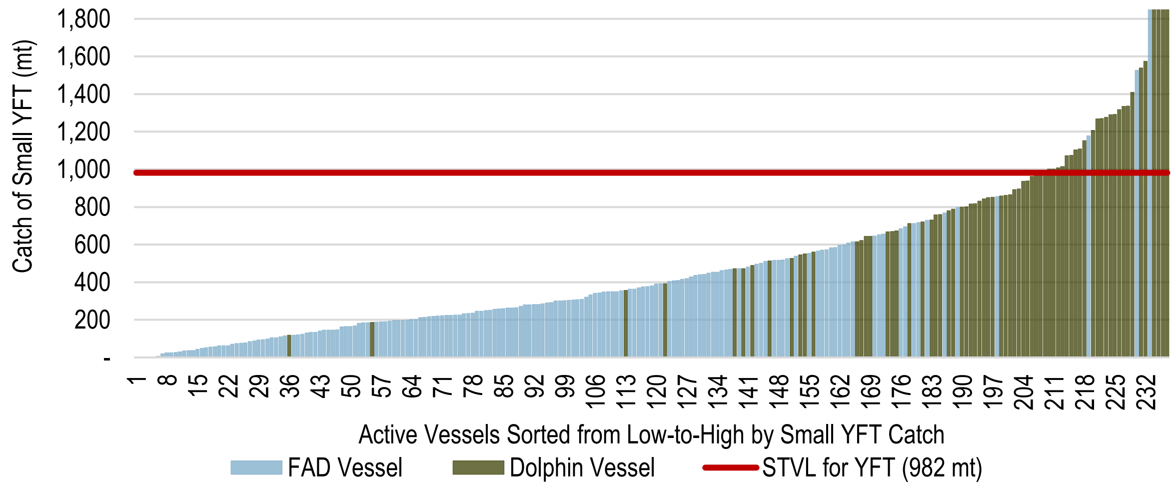


Figure ES-10. Estimated Catch of Small YFT by Vessel in 2016 Augmented with the Assumed STVL for YFT



Source: Developed by Northern Economics using IATTC data.

The NEI Team estimated impacts of the STVLs using a simulation model assuming that vessels are unable to change their behavior to limit harvests of small BET and YFT—negative impacts result from vessels reaching the cap, while positive impacts derive from additional fishing days. A total of 13 vessels are estimated to be limited by the BET STVL. Under the STVLs, 146 vessels will end up catching more BET (both small and large) than they did without the STVLs. The simulated 2016 harvests for YFT under STVLs indicate that a total of 42 vessels will end up being limited by the STVL for YFT—3 of which are FAD vessels and 39 of which are Dolphin vessels. Under the STVLs, 195 vessels will end up catching more YFT than they did without the STVLs.

After simulating total harvests under the STVLs, the NEI Team estimated the impacts on gross revenues by species and the impacts on NOR as shown in Table ES-8. For FAD vessels, gross revenues increase over all species combined by $47.5 million, and NOR for all FAD vessels combined increases by $25.6 million. For Dolphin vessels, gross revenues over all species combined decline by $18.7 million, and NOR for all Dolphin vessels decline from -$5.9 million to -$22.2 million, a total decline of $16.3 million.

Setting an STVL on BET appears to benefit the fleet overall while causing negative outcomes for relatively few vessels. However, the STVL for YFT, at least as modelled in this assessment, generates negative impacts for many Dolphin vessels which fish primarily for YFT. Unless they are able to change their behaviors, they will see reductions in both small and large YFT harvests.

Table ES-8. Changes in Gross Revenue by Species under STVLs, and Estimated NOR

Vessel Type	Revenue Change: YFT	Revenue Change: BET	Revenue Change: SKJ	Revenue Change: PBF* & Other	Actual 2016 NOR	NOR for 2016 with STVLs
FAD Vessels	$12,379,941	($30,159)	$32,802,059	$2,302,310	$303,757,967	$329,349,224
Dolphin Vessels	($18,916,796)	$71,445	$188,416	$8,126	($5,856,366)	($22,160,695)
All Vessels	($6,536,854)	$41,286	$32,990,476	$2,310,436	$297,901,601	$307,188,530

* Pacific bluefin tuna

ES-4.2.5 An Individual Vessel Quota Program

This program will implement a transferable IVQ program for BET and YFT. The transferable IVQ program is included because capacity in the fishery will be voluntarily removed under the program as more efficient vessels purchase quota from less efficient vessels. In addition, an IVQ program could address concerns expressed by the IATTC staff regarding the increasing harvests of smaller BET and YFT. As specified here, the IVQ program will distinguish between small and large tuna.

<u>Program Details:</u>

1) IATTC would set Annual Catch Limits (ACLs) and make a one-time allocation of IVQs for:
    a. Large BET over all set types (BET over 15 kg)
    b. Large YFT over all set types (YFT over 15 kg)
    c. Small BET over all set types (BET ≤ 15 kg)
    d. Small YFT over all set types (YFT ≤ 15 kg)
    e. An ACL for skipjack will not be set.
2) For purposes of this analysis, it is assumed the program would allocate IVQs based on catch history from the most recent three years (2014–2016) augmented with additional percentage allocations based on the capacity (m^3) of each authorized vessel listed in the IATTC Registry[1].
    a. Under Option 1, catch history would account for 75 percent of the total allocation, and capacity would account for 25 percent of the total IVQs allocated.
    b. Under Option 2, catch history would account for 66.7 percent of the total allocation, and capacity would account for 33.3 percent of the total IVQs allocated.
    c. Under Option 3, catch history accounts for 75 percent of the total allocation and then each vessel in the Register would be allocated an equal portion of the remaining IVQs.
    d. Under Option 4, catch history accounts for 90 percent of the allocation and 10 percent would be apportioned to the NFOs or SDOs to be used in fishery related programs.
3) The amount of small and large BET and YFT that will be issued to individual vessels will be based on the annual percentage estimates by set type of small and large BET and YFT.
4) Each year the IATTC would issue IVQ pounds to holders of IVQ shares for each species in proportion to their shareholdings, such that the sum of IVQ pounds equals the ACL.
5) The default assumption is that IVQs and IVQ pounds would be fully transferable, but other limits on transferability are discussed in the main body of the document.
6) Observer coverage will be enhanced with EM systems to reduce/eliminate discards at sea.
7) Plant inspectors will be increased so that 100 percent of vessel offloads can be observed. Their reports will be used to determine attainment of IVQs and splits of small and large fish.
8) Once a vessel uses all its IVQs for a species/size, it must quit fishing and return to port or acquire additional IVQs through a certified transfer.

<u>Assessment of Initial IVQ Allocation on a Vessel-by-Vessel Basis</u>

The vessel-by-vessel assessment of the initial allocation is built around successive figures that depict different allocation options for each species. Figure ES-11 and Figure ES-12 show allocations of BET under

[1] There are numerous methods to allocate IVQs and many formulations utilize near term catch histories modified to build in equity.

Options 2 and 3, while Figure ES-13 and Figure ES-14 show allocations of YFT. Figures for the other two IVQ options have not been included due to space considerations.

All the figures are organized in the same manner. The vertical bars in the figure represent the allocation to a single vessel as a percentage of the total allocation of IVQ for the species. Yellow bars represent Latent vessels, green bars represent Dolphin vessels and blue bars represent FAD vessels. In the figures all vessels are sorted first by their catch history of the species from 2014 to 2016. Then, vessels that did not have catch history for that species between 2014 and 2016 are sorted based on their total allocation. The two figures showing BET allocation are sorted identically, as are the two YFT figures.

A total of 81 of the 271 vessels on the IATTC register did not catch BET from 2014 to 2016, including 25 latent vessels, 28 Dolphin vessels, and 15 FAD vessels. Similarly, a total of 27 vessels did not land any YFT during the catch history period including the 25 latent vessels and two FAD vessels.

The black lines in all the figures represent the actual catch history of each vessel as a percent of total catch for the species from 2014 to 2016. If catch history from 2014 to 2016 was the only factor used in the allocation protocol, then each vessel's allocation (vertical bar) would correspond exactly to the black line. Vessels for which the allocation (vertical bar) exceeds the black line will receive more IVQs than their catch history alone would dictate. Vessels whose allocation falls short of the black line would receive fewer IVQs than their catch history dictates. It is clear that in general, vessels that caught the greatest share of the species will receive fewer IVQs under all these allocation Options than if the IVQ allocation was based purely on catch history. Finally, the light gray line in the figure represents the portion of the allocation that is based on catch history. Under Option 2, the gray Line is equivalent to 67 percent of the vessel's catch history, and under Option 3 the gray line represents 75 percent of the vessel's catch history.

Figure ES-11. Vessel-by-Vessel Allocation of BET under Option 2:
67% on Catch History | 33% on Capacity (m^3)

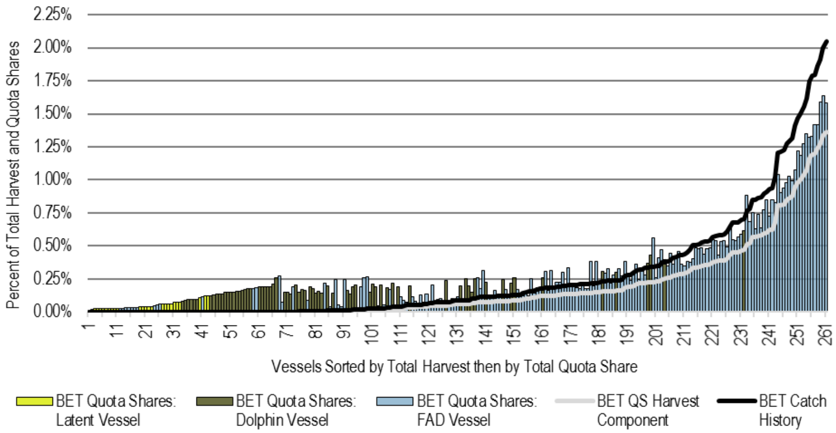


Figure ES-12. Vessel-by-Vessel Allocation of BET under Option 3:
75% on Catch History | 25% Divided Equally

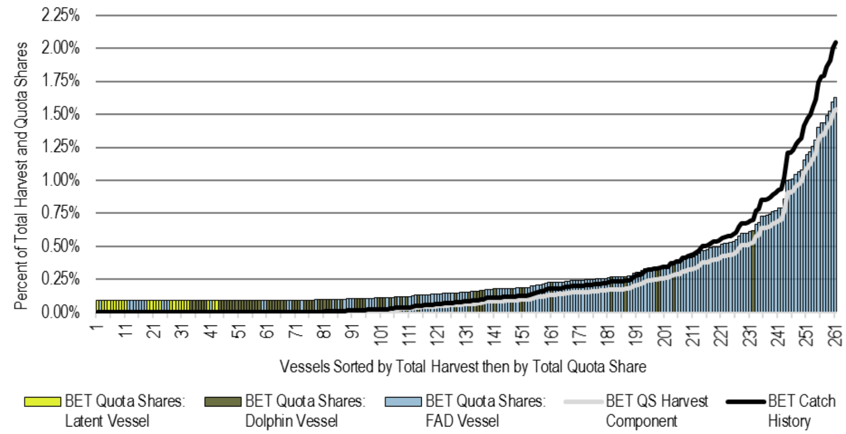


Figure ES-13. Vessel-by-Vessel Allocation of YFT under Option 2: 67% on Catch History | 33% on Capacity (m^3)

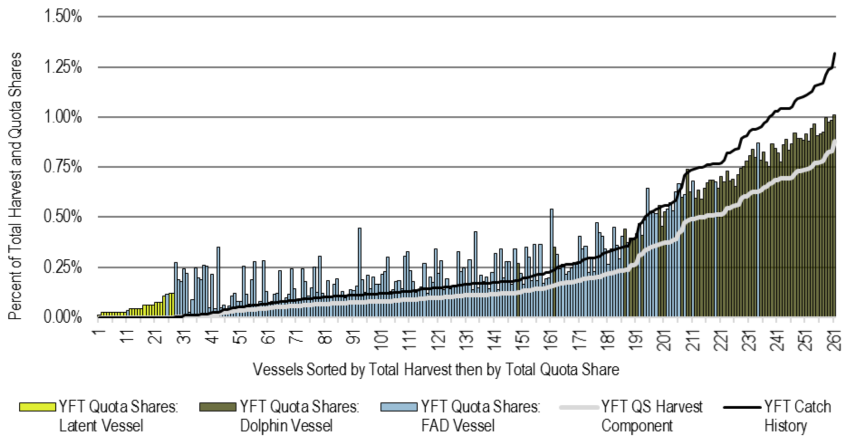
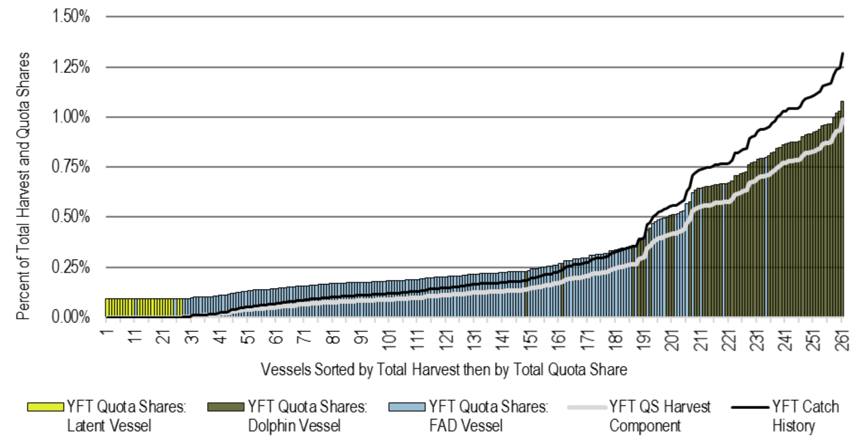


Figure ES-14. Vessel-by-Vessel Allocation of BET under Option 3:
75% on Catch History | 25% Divided Equally



Assessment of Potential Capacity Reduction under the IVQ Program

The NEI Team has assessed the potential capacity reduction under the IVQ program, while limiting assumptions of behavioral change. The following methodology was used:

1) Calculate the maximum expansion possible for each vessel, assuming maximum increases in trip numbers of average length (with BTSD of average length) but allowing a "last trip" to be shorter than average;
2) Calculate potential harvests of all species under this maximum, with the exception that Pacific bluefin tuna harvests are not allowed to expand;[2]
3) Calculate the **Expanded NOR**;
4) Sort vessels by **Expanded NOR**, but interleaving FAD vessels and Dolphin vessels such that the **Expanded Use of BET** and **Expanded Use of YFT** reach BET and YFT total harvest levels under the status quo at the same vessel.

Table ES-9 summarizes the optimized fleet under the IVQ Program. A total of 195 vessels are projected to remain in the fleet with a total capacity of 211,003 m^3. BET and YFT harvests will remain at or below status quo levels (2014–2016 average), and Total NOR for the active fleet increases by 169.4 percent to $345 million. In addition, inactive vessels generate an estimated $10.2 from IVQ leases.

Table ES-9. Summary Statistics of the Optimized Fleet under IVQs

Vessel Type	Count	Capacity (m^3)	BET Harvest (mt)	BET Percent of SQ	YFT Harvest (mt)	YFT Percent of SQ	NOR of Active Vessels	NOR percent of SQ	IVQ Lease Revenue: Inactive Vessels
FAD Vessels	139	136,977	58,818	99.3%	79,062	103.9%	$307,532,517	158.4%	$6,082,710
Dolphin Vessel	56	74,026	2,496	106.5%	162,482	98.2%	$38,448,041	379.6%	$4,113,167
All Vessels	**195**	**211,003**	**61,314**	**99.6%**	**241,544**	**100.0%**	**$345,980,558**	**169.4%**	**$10,195,877**

[2] PBF harvests are currently limited on an annual basis by the IATTC.