Can a Buyback Program Succeed in the EPO Tuna Fishery

A presentation by Marcus Hartley
President, Northern Economics, Inc.

July 18, 2018
Introduction

• The original project was funded by the World Bank under Agreement #TF018235 in a study directed by the World Wildlife Fund (WWF)

• Northern Economics, Inc. (NEI) of Anchorage Alaska, U.S.A. was the primary consultant

• Marcus L. Hartley, President of NEI is the principal investigator

• Dr. Sanitago Bucaram (now with Inter-American Development Bank) was the Technical Advisor

• Ideas and opinions presented here are Mr. Hartley’s and do not necessarily represent the policies of the World Bank, the World Wildlife Fund, or the Inter-American Tropical Tuna Commission.
Alternatives to Address Excess Capacity in the Eastern Pacific Purse Seine Tuna Fishery

Final Report

April 2018
Outline of Presentation

• Existing Conditions in the Fishery
• Assessment of Outcomes Under a Vessel Buyback
• Optimization of the Vessel Buyback
Outline of Presentation

• Existing Conditions in the Fishery
Outline of Presentation

• Existing Conditions in the Fishery
• Assessment of Outcomes Under a Vessel Buyback
Outline of Presentation

• Existing Conditions in the Fishery
• Assessment of Outcomes Under a Vessel Buyback
• Optimization of the Vessel Buyback
The EPO Purse Seine Fishery

- Managed by the Inter-American Tropical Tuna Commission (IATTC)
- IATTC operates on a consensus basis with 21 member states.
- Three primary species, Skipjack tuna (SKJ), Bigeye (BET), and Yellowfin (YFT).
- Capacity increases leading to harvests in excess of sustainable levels.
- Closure periods are used to limit harvests rather than annual catch limits.
The EPO Purse Seine Fishery

- Managed by the Inter-American Tropical Tuna Commission (IATTC)
- Operates on a consensus basis with 21 member states.
- Three primary species, Skipjack tuna (SKJ), Bigeye (BET), and Yellowfin (YFT)
- Capacity increases leading to harvests in excess of sustainable levels
- Closure periods are used to limit harvests rather than annual catch limits
IATTC and other Regional Fishery Management Organization (RFMOs)
The EPO Purse Seine Fishery

- Managed by the Inter-American Tropical Tuna Commission (IATTC)
- IATTC operates on a consensus basis with 21 member states.
# IATTC Member States

<table>
<thead>
<tr>
<th>IATTC Member States (21)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Belize</td>
<td>Canada</td>
</tr>
<tr>
<td>Chinese Taipei</td>
<td>Colombia</td>
</tr>
<tr>
<td>Ecuador</td>
<td>El Salvador</td>
</tr>
<tr>
<td>France</td>
<td>Guatemala</td>
</tr>
<tr>
<td>Kiribati</td>
<td>Korea</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>Panama</td>
</tr>
<tr>
<td>United States</td>
<td>Vanuatu</td>
</tr>
</tbody>
</table>

## Cooperating Non-Members (5)

<table>
<thead>
<tr>
<th>Bolivia</th>
<th>Chile</th>
<th>Honduras</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>Liberia</td>
<td></td>
</tr>
</tbody>
</table>
The EPO Purse Seine Fishery

• Managed by the Inter-American Tropical Tuna Commission (IATTC)
• IATTC operates on a consensus basis with 21 member states.
• Three primary species, Skipjack tuna (SKJ), Bigeye (BET), and Yellowfin (YFT)

• Capacity increases leading to harvests in excess of sustainable levels
• Closure periods are used to limit harvests rather than annual catch limits
Catch by Species in the EPO Purse Seine Fishery

<table>
<thead>
<tr>
<th>Year</th>
<th>Skipjack (SKJ)</th>
<th>Yellowfin (YFT)</th>
<th>Bigeye (BET)</th>
<th>Pacific Bluefin (PBF) and Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The EPO Purse Seine Fishery

- Managed by the Inter-American Tropical Tuna Commission (IATTC)
- IATTC operates on a consensus basis with 21 member states.
- Three primary species, Skipjack tuna (SKJ), Bigeye (BET), and Yellowfin (YFT)
- Capacity increases lead to harvests in excess of sustainable levels
Distribution of Purse Seine Vessels by Unofficial Size Groups

Number of Vessels

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 425 m³</td>
<td>426 - 850 m³</td>
<td>851 - 1,270 m³</td>
<td>1,271 - 1,600 m³</td>
<td>1,601 - 3,300 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Distribution of Purse Seine Vessels by Unofficial Size Groups

Classes 1, 2, 3, 4, & 5

Number of Vessels

- 1 – 425 m³
- 426 – 850 m³
- 851 – 1,270 m³
- 1,271 – 1,600 m³
- 1,601 – 3,300 m³

Years:
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
Distribution of Purse Seine Vessels by Unofficial Size Groups

Classes 1, 2, 3, 4, & 5

Number of Vessels

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 425 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>426 - 850 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>851 - 1,270 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,271 - 1,600 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,601 - 3,300 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Distribution of Purse Seine Vessels by Unofficial Size Groups

Classes 1, 2, 3, 4, & 5

Class 6
Distribution of Purse Seine Vessels by Unofficial Size Groups

Classes 1, 2, 3, 4, & 5

Class 6
Distribution of Purse Seine Vessels by Unofficial Size Groups

Classes 1, 2, 3, 4, & 5

Class 6
Distribution of Purse Seine Vessels by Size Class

Classes 1, 2, 3, 4, & 5

Class 6
The EPO Purse Seine Fishery

- Managed by the Inter-American Tropical Tuna Commission (IATTC)
- IATTC operates on a consensus basis with 21 member states.
- Three primary species, Skipjack tuna (SKJ), Bigeye (BET), and Yellowfin (YFT)
- Capacity increases lead to harvests in excess of sustainable levels
- Closure periods are used to limits harvests rather than annual catch limits
Closure Periods in the EPO Purse Seine Fishery

- 2002: a 31-day closure during the month of December
- 2003: closure expanded to 42 days from Aug 1 – Sep 11
- 2004: two 42-day closure period choices: (August 1 – September 11 or November 20 – December 31)
- 2009: Closure periods expanded to 59 days, but Class 1–3 vessels were exempt & Class 4 allowed a shorter closure.
- 2010: Closure periods expanded to 62 days, with exemptions
- 2018: Closure periods expanded to 72 days with exemptions
Closure Periods in the EPO Purse Seine Fishery

- 2002: a 31-day closure during the month of December
Closure Periods in the EPO Purse Seine Fishery

- 2002: a 31-day closure during the month of December
- 2003: closure expanded to 42 days from Aug 1–Sep 11
- 2004: two 42-day closure period choices: (August 1–September 11 or November 20–December 31)
- 2009: Closure periods expanded to 59 days, but Class 1–3 vessels were exempt & Class 4 allowed a shorter closure.
- 2010: Closure periods expanded to 62 days, with exemptions
- 2018: Closure periods expanded to 72 days with exemptions
Closure Periods in the EPO Purse Seine Fishery

- 2002: a 31-day closure during the month of December
- 2003: closure expanded to 42 days from Aug 1–Sep 11
- 2004: two 42-day closure period choices: (August 1–September 11 or November 20–December 31)
- 2009: Closure periods expanded to 59 days, but Class 1–3 vessels were exempt & Class 4 allowed a shorter closure.
- 2010: Closure periods expanded to 62 days, with exemptions
- 2018: Closure periods expanded to 72 days with exemptions
Closure Periods in the EPO Purse Seine Fishery

- 2002: a 31-day closure during the month of December
- 2003: closure expanded to 42 days from Aug 1–Sep 11
- 2004: two 42-day closure period choices: (August 1–September 11 or November 20–December 31)
- 2009: Closure periods expanded to 59 days, but Class 1–3 vessels were exempt & Class 4 allowed a shorter closure
Closure Periods in the EPO Purse Seine Fishery

- 2002: a 31-day closure during the month of December
- 2003: closure expanded to 42 days from Aug 1–Sep 11
- 2004: two 42-day closure period choices: (August 1–September 11 or November 20–December 31)
- 2009: Closure periods expanded to 59 days, but Class 1–3 vessels were exempt & Class 4 allowed a shorter closure
- 2010: Closure periods expanded to 62 days, with exemptions
Closure Periods in the EPO Purse Seine Fishery

• 2002: a 31-day closure during the month of December
• 2003: closure expanded to 42 days from Aug 1–Sep 11
• 2004: two 42-day closure period choices: (August 1–September 11 or November 20–December 31)
• 2009: Closure periods expanded to 59 days, but Class 1–3 vessels were exempt & Class 4 allowed a shorter closure
• 2010: Closure periods expanded to 62 days, with exemptions
• 2018: Closure periods expanded to 72 days with exemptions
The EPO Purse Seine Fishery:

The EPO comprises two very different fisheries with two types of vessels:

FAD Vessels and Dolphin Vessels

FAD Vessel Countries: 80 percent + of landings
- Ecuador, Spain, United States (U.S.), Peru, and one other

Dolphin Vessel Countries: 80 percent + of landings
- Mexico, Venezuela, El Salvador

Mixed Countries:
- Colombia, Panama and Nicaragua
The EPO Purse Seine Fishery: A two-for-one special
The EPO Purse Seine Fishery: A two-for-one special

- The EPO comprises two very different fisheries with two types of vessels
The EPO Purse Seine Fishery: A two-for-one special

- The EPO comprises two very different fisheries with two types of vessels
- FAD Vessels and Dolphin Vessels
Vessel Counts by Vessel Type

- FAD Vessels
- Dolphin Vessels
Total Capacity by Vessel Type

- **Dolphin vessels**
- **FAD vessels**

<table>
<thead>
<tr>
<th>Fishing Year</th>
<th>Total Hold Capacity (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>100,000</td>
</tr>
<tr>
<td>2008</td>
<td>100,000</td>
</tr>
<tr>
<td>2009</td>
<td>100,000</td>
</tr>
<tr>
<td>2010</td>
<td>100,000</td>
</tr>
<tr>
<td>2011</td>
<td>100,000</td>
</tr>
<tr>
<td>2012</td>
<td>100,000</td>
</tr>
<tr>
<td>2013</td>
<td>125,000</td>
</tr>
<tr>
<td>2014</td>
<td>150,000</td>
</tr>
<tr>
<td>2015</td>
<td>175,000</td>
</tr>
<tr>
<td>2016</td>
<td>200,000</td>
</tr>
</tbody>
</table>
Average Vessel Capacity (m$^3$) by Vessel Type

Average Hold Capacity (m$^3$)

Dolphin vessels

FAD vessels

Fishing Year


Northern Economics
Harvest by Species and Vessel Type

Metric Tons Landed (1,000s)

Dolphin vessels

FAD vessels


SKJ YFT BET PBF & Other

Northern Economics
Harvest by Species and Vessel Type

Note differences in catch composition

Metric Tons Landed (1,000s)

Dolphin vessels

FAD vessels


SKJ  YFT  BET  PBF & Other

Northern Economics
Average Catch Per Vessel by Species and Type

- **Dolphin vessels**
  - SKJ
  - YFT
  - BET
  - PBF & Other

- **FAD vessels**

<table>
<thead>
<tr>
<th>Year</th>
<th>Metric Tons Landed</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td></td>
</tr>
</tbody>
</table>
The EPO Purse Seine Fishery: A two-for-one special

- The EPO comprises two very different fisheries with two types of vessels
- FAD Vessels and Dolphin Vessels
The EPO Purse Seine Fishery: A two-for-one special

- The EPO comprises two very different fisheries with two types of vessels
- FAD Vessels and Dolphin Vessels
- FAD Vessel Countries: 80 percent + of landings
  - Ecuador, Spain, United States, Peru, and one other
The EPO Purse Seine Fishery: A two-for-one special

- The EPO comprises two very different fisheries with two types of vessels
- FAD Vessels and Dolphin Vessels
  - FAD Vessel Countries: 80 percent + of landings
    - Ecuador, Spain, United States, Peru, and one other
  - Dolphin Vessel Countries: 80 percent + of landings
    - Mexico, Venezuela, El Salvador
The EPO Purse Seine Fishery: A two-for-one special

- The EPO comprises two very different fisheries with two types of vessels
- FAD Vessels and Dolphin Vessels
  - FAD Vessel Countries: 80 percent + of landings
    - Ecuador, Spain, United States, Peru, and one other
  - Dolphin Vessel Countries: 80 percent + of landings
    - Mexico, Venezuela, El Salvador
- Mixed Countries:
  - Columbia, Panama and Nicaragua
Catch by Country Type

Metric Tons (1,000s)

FAD Countries

Dolphin Countries

Mixed Countries


SKJ
YFT
BET
PBF & Other

Northern Economics
Cost Data

Dr. Bucaram collected data through interviews with FAD Vessel Owners from Ecuador, with Dolphin Vessel Owners from Mexico and Panama. Small sample size, but judged to be reasonably representative. Dolphin vessel costs used to represent costs of all vessels from developed countries (Mexico, U.S., Spain). FAD Vessel costs used to represent costs of all other vessels with adjustments for fuel costs. Costs calculated per m$^3$ and applied to individual vessels.
Cost Data

- Dr. Bucaram collected data through interviews
  - with FAD Vessel Owners from Ecuador
  - with Dolphin Vessel Owners from Mexico and Panama

- Small sample size, but judged to be reasonably representative
- Dolphin vessel costs used to represent costs of all vessels from developed countries (Mexico, U.S., Spain)
- FAD Vessel costs used to represent costs of all other vessels with adjustments for fuel costs
- Costs calculated per $m$ and applied to individual vessels
Cost Data

• Dr. Bucaram collected data through interviews
  • with FAD Vessel Owners from Ecuador
  • with Dolphin Vessel Owners from Mexico and Panama
• Small sample size, but judged to be reasonably representative
Cost Data

- Dr. Bucaram collected data through interviews
  - with FAD Vessel Owners from Ecuador
  - with Dolphin Vessel Owners from Mexico and Panama
- Small sample size, but judged to be reasonably representative
- Dolphin vessel costs used to represent costs of all vessels from developed countries (Mexico, U.S. Spain)
Cost Data

- Dr. Bucaram collected data through interviews
  - with FAD Vessel Owners from Ecuador
  - with Dolphin Vessel Owners from Mexico and Panama
- Small sample size, but judged to be reasonably representative
- Dolphin vessel costs used to represent costs of all vessels from developed countries (Mexico, U.S. Spain)
- FAD Vessels costs used to represent costs of all other vessels with adjustments for fuel costs
Cost Data

• Dr. Bucaram collected data through interviews
  • with FAD Vessel Owners from Ecuador
  • with Dolphin Vessel Owners from Mexico and Panama

• Small sample size, but judged to be reasonably representative

• Dolphin vessel costs used to represent costs of all vessels from developed countries (Mexico, U.S. Spain)

• FAD Vessels costs used to represent costs of all other vessels with adjustments for fuel costs

• Costs calculated per m$^3$ and applied to individual vessels
Average Operating Costs per Vessel

- Labor Cost
- Fuel Cost
- Other Trip Cost
- Annual Participation Cost

Dolphin Vessels

FAD Vessels
Tuna Prices (nominal)

Ex-Vessel Prices ($US/MT)

- Bigeye Tuna
- Skipjack Tuna
- Yellowfin Tuna

Years: 2005 to 2016
Average Revenue per Vessel

Estimated Ex-Vessel Revenue ($ US Millions)

- SKJ
- YFT
- BET
- PBF & Other


Dolphin Vessels
FAD Vessels
Net Operating Revenue (NOR): Average per Vessel by Year

[Bar chart showing the estimated NOR per vessel in millions US for different years, with bars for Dolphin Vessels and FAD Vessels.]

- Dolphin Vessels
  - 2007: $-0.50
  - 2008: $0.50
  - 2009: $1.00
  - 2010: $1.50
  - 2011: $2.00
  - 2012: $2.50
  - 2013: $3.00

- FAD Vessels
  - 2007: $-0.50
  - 2008: $0.50
  - 2009: $1.00
  - 2010: $1.50
  - 2011: $2.00
  - 2012: $2.50
  - 2013: $3.00

Distribution of NOR by Vessel-Year

Net Operating Revenue ($ Millions US)

Dolphin Vessels

FAD Vessels

Percent of Active of Vessel-Years

Vessels with Negative NOR
Vessels with Positive NOR

($5.0M–$2.5M)
($2.5M–$0.0M)
$0.0M–$2.5M
$2.5M–$5.0M
$5.0M–$7.5M
$7.5M–$10.0M
$10.0M +
Dolphin Vessels v FAD Vessels

Dolphin Vessels:
- Are larger and more costly to operate than FAD Vessels on average
- Are more likely to have lost money in recent years
- Catch primarily Yellowfin with smaller amounts of skipjack and very little bigeye

FAD Vessels
- Catch primarily skipjack and have lesser amounts of yellowfin bigeye
Dolphin Vessels v FAD Vessels

- **Dolphin Vessels:**
  - Are larger and more costly to operate than FAD Vessels on average
- **FAD Vessels:**
  - Catch primarily skipjack and have lesser amounts of yellowfin and bigeye
Dolphin Vessels v FAD Vessels

- Dolphin Vessels:
  - Are larger and more costly to operate than FAD Vessels on average
  - Are more likely to have lost money in recent years

- FAD Vessels:
  - Catch primarily skipjack and have lesser amounts of yellowfin and bigeye
Dolphin Vessels v FAD Vessels

- **Dolphin Vessels:**
  - Are larger and more costly to operate than FAD Vessels on average
  - Are more likely to have lost money in recent years
  - Catch primarily Yellowfin with smaller amounts of skipjack and very little bigeye

- **FAD Vessels**
  - Catch primarily skipjack and have lesser amounts of yellowfin bigeye
Dolphin Vessels v FAD Vessels

• Dolphin Vessels:
  • Are larger and more costly to operate than FAD Vessels on average
  • Are more likely to have lost money in recent years
  • Catch primarily Yellowfin with smaller amounts of skipjack and very little bigeye

• FAD Vessels
  • Catch primarily skipjack and have lesser amounts of yellowfin bigeye
Alternatives Addressed in the Paper

The full document included a series of alternatives designed to reduce capacity including:

1) A series of "small steps" that facilitate approval and implementation of more significant measures
2) A phased-in capacity reduction program that would reduce capacity by 10 percent per year
3) A fishery-wide vessel buyback program
4) Buyback Programs in Individual Countries
5) An Individual Vessel Quota Program
6) Annual limits on the harvest of small BET and YFT
Alternatives Addressed in the Paper

The full document included a series of alternatives designed to reduce capacity including:

1) A series of “small steps” that facilitate approval and implementation of more significant measures
Alternatives Addressed in the Paper

The full document included a series of alternatives designed to reduce capacity including:

1) A series of “small steps” that facilitate approval and implementation of more significant measures

2) phased-in capacity reduction program that would reduce capacity by 10 percent per year
Alternatives Addressed in the Paper

The full document included a series of alternatives designed to reduce capacity including:

1) A series of “small steps” that facilitate approval and implementation of more significant measures

2) phased-in capacity reduction program that would reduce capacity by 10 percent per year

3) A fishery-wide vessel buyback program
Alternatives Addressed in the Paper

The full document included a series of alternatives designed to reduce capacity including:

1) A series of “small steps” that facilitate approval and implementation of more significant measures

2) phased-in capacity reduction program that would reduce capacity by 10 percent per year

3) A fishery-wide vessel buyback program

4) Buyback Programs in Individual Countries
Alternatives Addressed in the Paper

The full document included a series of alternatives designed to reduce capacity in the included:

1) A series of “small steps” that facilitate approval and implementation of more significant measures

2) phased-in capacity reduction program that would reduce capacity by 10 percent per year

3) A fishery-wide vessel buyback program

4) Buyback Programs in Individual Countries

5) An Individual Vessel Quota Program
Alternatives Addressed in the Paper

The full document included a series of alternatives designed to reduce capacity including:

1) A series of “small steps” that facilitate approval and implementation of more significant measures

2) phased-in capacity reduction program that would reduce capacity by 10 percent per year

3) A fishery-wide vessel buyback program

4) Buyback Programs in Individual Countries

5) An Individual Vessel Quota Program

6) Annual limits on the harvest of small BET and YFT
A Vessel Buyback Program

• Vessel Program Objectives
  • Remove enough capacity to reduce or eliminate closure days

• Analytical Objectives
  • How much capacity must be removed?
  • What will it cost?
A Vessel Buyback Program

- Vessel Buyback Program Objectives
A Vessel Buyback Program

- Vessel Buyback Program Objectives
  - Remove enough capacity to reduce or eliminate closure days
A Vessel Buyback Program

- Vessel Buyback Program Objectives
  - Remove enough capacity to reduce or eliminate closure days
- Analytical Objectives
A Vessel Buyback Program

• Vessel Buyback Program Objectives
  • Remove enough capacity to reduce or eliminate closure days

• Analytical Objectives
  • How much capacity must be removed?
A Vessel Buyback Program

• Vessel Buyback Program Objectives
  • Remove enough capacity to reduce or eliminate closure days

• Analytical Objectives
  • How much capacity must be removed?
  • What will it cost?
Buyback Program Assumptions

• Funded with a 20-year loan with a 10% rate of interest
• Remaining vessels must pay back the loan
• Assume that annual payments are made as a tax on ex-vessel revenues
Buyback Program Assumptions

- Funded with a 20-year loan with a 10% rate of interest
Buyback Program Assumptions

• Funded with a 20-year loan with a 10% rate of interest
• Remaining vessels must pay back the loan
Buyback Program Assumptions

• Funded with a 20-year loan with a 10% rate of interest
• Remaining vessels must pay back the loan
• Assume that annual payments are made as a tax on ex-vessel revenues
Buyback Program Assumptions

• Funded with a 20-year loan with a 10% rate of interest
• Remaining vessels must pay back the loan
• Assume that annual payments are made as a tax on ex-vessel revenues
• Grants from NGOs or national fisheries organizations could reduce costs.
Assessment of the Vessel Buyback

• Estimate Present Value of Future Earnings (PVFE) of each vessel

• Assign minimum values to vessels with negative PVFE or with PVFE = 0

• Assume that in a buyback vessels are willing to sell their vessel at the PVFE or the minimum value (whichever is greater)

• Bid Price = max of PVFE or Minimum Bid

• Rank vessels from low to high by their Bid/m

• If two vessels have the same bid, the larger vessel will be selected before the smaller vessel
Assessment of the Vessel Buyback

- Estimate Present Value of Future Earnings (PVFE) of each vessel
  - Assign minimum values to vessels with negative PVFE or PVFE = 0 (e.g. latent vessels)
  - Assume that in a buyback vessels are willing to sell their vessel at the PVFE or the minimum value (whichever is greater)
  - Bid Price = max of PVFE or Minimum Bid
  - Rank vessels from low to high by their Bid/m
  - If two vessels have the same bid, the larger vessel will be selected before the smaller vessel
Assessment of the Vessel Buyback

- Estimate Present Value of Future Earnings (PVFE) of each vessel
- Assign minimum values to vessels with negative PVFE or with PVFE = 0 (e.g. latent vessels)

- Bid Price = max of PVFE or Minimum Bid
- Rank vessels from low to high by their Bid/m
  - If two vessels have the same bid, the larger vessel will be selected before the smaller vessel
Assessment of the Vessel Buyback

- Estimate Present Value of Future Earnings (PVFE) of each vessel
- Assign minimum values to vessels with negative PVFE or with PVFE = 0 (e.g. latent vessels)
- Assume that in a buyback vessels are willing to sell their vessel at the PVFE or the minimum value (whichever is greater)
  - Bid Price = max of PVFE or Minimum Bid
Assessment of the Vessel Buyback

• Estimate Present Value of Future Earnings (PVFE) of each vessel

• Assign minimum values to vessels with negative PVFE or with PVFE = 0 (e.g. latent vessels)

• Assume that in a buyback vessels are willing to sell their vessel at the PVFE or the minimum value (whichever is greater)
  • Bid Price = max of PVFE or Minimum Bid

• Rank vessels from low to high by their Bid/m³
Assessment of the Vessel Buyback

- Estimate Present Value of Future Earnings (PVFE) of each vessel
- Assign minimum values to vessels with negative PVFE or with $\text{PVFE} = 0$ (e.g. latent vessels)
- Assume that in a buyback vessels are willing to sell their vessel at the PVFE or the minimum value (whichever is greater)
  - Bid Price = max of PVFE or Minimum Bid
- Rank vessels from low to high by their Bid/m$^3$
  - If two vessels have the same bid, the larger vessel will be selected before the smaller vessel
Distribution of PVFEs of 271 EPO Purse Seine Vessels

Estimated Present Value of Future Earnings ($US Millions)

- ($15M) - ($10M)
- ($9.9M) - ($5M)
- ($4.9M) - ($0.1M)
- Authorized/Latent
  - $0.1M to $5M
  - $5.1M to $10M
  - $10.1M to $15M
  - $15.1M to $20M
  - $21.1M to $25M
  - $25.1M to $30M
  - $30.1M to $35M
  - $35.1M to $40M
  - More than $40.1M

Number of Vessels

- Vessels with Negative NOR
- Vessels with Positive NOR
- Authorized/Latent Vessels
Estimation of Harvest Potential of Remaining Fleet

• Iteratively remove vessels—lowest rank first
• Catch per day of the remaining fleet will be smaller after each active vessel is removed
• The remaining fleet can access harvests foregone by the vessels that were bought out
• Closure periods are assumed to be successively reduced until the point that the remaining fleet will need to entire year to catch the same amount harvested by the original fleet.
• Closure period reduction = Catch foregone by exiting vessels ÷ Catch per day of the remaining fleet.
Estimation of Harvest Potential of Remaining Fleet

- Iteratively remove vessels—lowest rank first
Estimation of Harvest Potential of Remaining Fleet

- Iteratively remove vessels—lowest rank first
- Catch per day of the remaining fleet will be smaller after each active vessel is removed
Estimation of Harvest Potential of Remaining Fleet

- Iteratively remove vessels—lowest rank first
- Catch per day of the remaining fleet will be smaller after each active vessel is removed
- The remaining fleet can access harvests foregone by the vessels that were bought out
Estimation of Harvest Potential of Remaining Fleet

• Iteratively remove vessels—lowest rank first
• Catch per day of the remaining fleet will be smaller after each active vessel is removed
• The remaining fleet can access harvests foregone by the vessels that were bought out
• Closure periods are assumed to be successively reduced until the point that the remaining fleet will need to entire year to catch the same amount harvested by the original fleet.
Estimation of Harvest Potential of Remaining Fleet

• Iteratively remove vessels—lowest rank first
• Catch per day of the remaining fleet will be smaller after each active vessel is removed
• The remaining fleet can access harvests foregone by the vessels that were bought out
• Closure periods are assumed to be successively reduced until the point that the remaining fleet will need to entire year to catch the same amount harvested by the original fleet.
• Closure period reduction = \( \frac{\text{Catch foregone by exiting vessels}}{\text{Catch per day of the remaining fleet}} \).
But …

• Dolphin vessels have higher costs and lower PVFEs.
• Dolphin vessels are more likely than FAD vessels to be removed.
• Dolphin vessels catch more Yellowfin than FAD vessels.
• Dolphin vessels catch de minimus amounts of Bigeye.
• The number of vessels needed to be removed to keep yellowfin harvests at sustainable levels is relatively low.
• The number of vessels needed to be removed to keep bigeye harvests at sustainable levels is relatively high.
But ...

- Dolphin vessels have higher costs and lower PVFEs
But ...

- Dolphin vessels have higher costs and lower PVFEs
- Dolphin vessels are more likely than FAD vessels to be removed.
But ...

• Dolphin vessels have higher costs and lower PVFEs
• Dolphin vessels are more likely than FAD vessels to be removed.
• Dolphin vessels catch more Yellowfin than FAD vessels
But ...

• Dolphin vessels have higher costs and lower PVFEs
• Dolphin vessels are more likely than FAD vessels to be removed.
• Dolphin vessels catch more Yellowfin than FAD vessels
• Dolphin vessels catch *de minimus* amounts of Bigeye
But …

- Dolphin vessels have higher costs and lower PVFEs
- Dolphin vessels are more likely than FAD vessels to be removed.
- Dolphin vessels catch more Yellowfin than FAD vessels
- Dolphin vessels catch \textit{de minimus} amounts of Bigeye
- The number of vessels needed to be removed to keep yellowfin harvests at sustainable levels is relatively low
But …

• Dolphin vessels have higher costs and lower PVFEs
• Dolphin vessels are more likely than FAD vessels to be removed.
• Dolphin vessels catch more Yellowfin than FAD vessels
• Dolphin vessels catch *de minimus* amounts of Bigeye
• The number of vessels needed to be removed to keep yellowfin harvests at sustainable levels is relatively low
• The number of vessels needed to be removed to keep bigeye harvests at sustainable levels is relatively high
Buyback that Eliminates Closure Periods assuming a $2 million Minimum Bid
Total Buyback Cost is $215 Million

<table>
<thead>
<tr>
<th>Remove Enough Capacity to Completely Eliminate Closure Days</th>
<th>FAD Vessels</th>
<th>Dolphin Vessels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Vessels Removed</td>
<td>28</td>
<td>36</td>
</tr>
<tr>
<td>Number of Active Vessels Remaining</td>
<td>129</td>
<td>50</td>
</tr>
<tr>
<td>Vessel Capacity Removed (m³)</td>
<td>44,627</td>
<td>51,813</td>
</tr>
<tr>
<td>Vessel Capacity Remaining (m³)</td>
<td>109,358</td>
<td>63,829</td>
</tr>
<tr>
<td>Average Capacity (m³) per Remaining Vessel</td>
<td>848</td>
<td>1,277</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Revenues and NOR After the Buyback but Accounting for the Cost of the Buyback</th>
<th>FAD Vessels</th>
<th>Dolphin Vessels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Total Vessel Revenue as a % of SQ Revenue</td>
<td>105.7%</td>
<td>76.4%</td>
</tr>
<tr>
<td>Estimated Revenue per Active Vessel as a % of SQ</td>
<td>120.8%</td>
<td>120.9%</td>
</tr>
<tr>
<td>Net Operating Revenue Gain per Active Vessel from additional harvests due to closure period reductions</td>
<td>$462,358</td>
<td>$350,301</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fleetwide Average Buyback Fees and Dolphin Vessel NOR After Deducting Fleetwide Average Buyback Fees</th>
<th>FAD Vessels</th>
<th>Dolphin Vessels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default Average Payment per Active Vessel (All Types)</td>
<td>$96,185</td>
<td>$141,610</td>
</tr>
<tr>
<td>NOR Gains per Active Vessel After Deducting Average Buyback Fee</td>
<td>$366,173</td>
<td>$208,691</td>
</tr>
<tr>
<td>Ratio of Annual NOR gains Less Fee to Annual Fee</td>
<td>3.81</td>
<td>1.47</td>
</tr>
</tbody>
</table>

Notes:
1) All 28 latent vessels are removed (at $2 million each). A total 92 vessels are out with 110,618 m³.
2) Assumes a 20-year buyback loan at 10% interest per year is repaid with an annual payment calculated as a percentage tax on ex-vessel value.
Buyback that Eliminates Closure Periods assuming a $2 million Minimum Bid
Total Buyback Cost is $215 Million

<table>
<thead>
<tr>
<th></th>
<th>FAD Vessels</th>
<th>Dolphin Vessels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove Enough Capacity to Completely Eliminate Closure Days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Vessels Removed</td>
<td>28</td>
<td>36</td>
</tr>
<tr>
<td>Number of Active Vessels Remaining</td>
<td>129</td>
<td>50</td>
</tr>
<tr>
<td>Vessel Capacity Removed (m³)</td>
<td>44,627</td>
<td>51,813</td>
</tr>
<tr>
<td>Vessel Capacity Remaining (m³)</td>
<td>109,358</td>
<td>63,829</td>
</tr>
<tr>
<td>Average Capacity (m³) per Remaining Vessel</td>
<td>848</td>
<td>1,277</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Revenues and NOR After the Buyback but Accounting for the Cost of the Buyback</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Total Vessel Revenue as a % of SQ Revenue</td>
<td>105.7%</td>
<td>76.4%</td>
</tr>
<tr>
<td>Estimated Revenue per Active Vessel as a % of SQ</td>
<td>120.8%</td>
<td>120.9%</td>
</tr>
<tr>
<td>Net Operating Revenue Gain per Active Vessel from additional harvests due to closure period reductions</td>
<td>$462,358</td>
<td>$350,301</td>
</tr>
</tbody>
</table>

| Fleetwide Average Buyback Fees and Dolphin Vessel NOR After Deducting Fleetwide Average Buyback Fees |             |                 |
| Default Average Payment per Active Vessel (All Types)                               | $96,185     | $141,610        |
| NOR Gains per Active Vessel After Deducting Average Buyback Fee                     | $366,173    | $208,691        |
| Ratio of Annual NOR gains Less Fee to Annual Fee                                    | 3.81        | 1.47            |

Notes:
1) All 28 latent vessels are removed (at $2 million each). A total 92 vessels are out with 110,618 m³.
2) Assumes a 20-year buyback loan at 10% interest per year is repaid with an annual payment calculated as a percentage tax on ex-vessel value.
Buyback that Eliminates Closure Periods
assuming a $2 million Minimum Bid
Total Buyback Cost is $215 Million

<table>
<thead>
<tr>
<th>Remove Enough Capacity to Completely Eliminate Closure Days</th>
<th>FAD Vessels</th>
<th>Dolphin Vessels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Vessels Removed</td>
<td>28</td>
<td>36</td>
</tr>
<tr>
<td>Number of Active Vessels Remaining</td>
<td>129</td>
<td>50</td>
</tr>
<tr>
<td>Vessel Capacity Removed (m³)</td>
<td>44,627</td>
<td>51,813</td>
</tr>
<tr>
<td>Vessel Capacity Remaining (m³)</td>
<td>109,358</td>
<td>63,829</td>
</tr>
<tr>
<td>Average Capacity (m³) per Remaining Vessel</td>
<td>848</td>
<td>1,277</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Revenues and NOR After the Buyback but Accounting for the Cost of the Buyback</th>
<th>FAD Vessels</th>
<th>Dolphin Vessels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Total Vessel Revenue as a % of SQ Revenue</td>
<td>105.7%</td>
<td>76.4%</td>
</tr>
<tr>
<td>Estimated Revenue per Active Vessel as a % of SQ</td>
<td>120.8%</td>
<td>120.9%</td>
</tr>
<tr>
<td>Net Operating Revenue Gain per Active Vessel from additional harvests due to closure period reductions</td>
<td>$462,358</td>
<td>$350,301</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fleetwide Average Buyback Fees and Dolphin Vessel NOR After Deducting Fleetwide Average Buyback Fees</th>
<th>FAD Vessels</th>
<th>Dolphin Vessels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default Average Payment per Active Vessel (All Types)</td>
<td>$96,185</td>
<td>$141,610</td>
</tr>
<tr>
<td>NOR Gains per Active Vessel After Deducting Average Buyback Fee</td>
<td>$366,173</td>
<td>$208,691</td>
</tr>
<tr>
<td>Ratio of Annual NOR gains Less Fee to Annual Fee</td>
<td>3.81</td>
<td>1.47</td>
</tr>
</tbody>
</table>

Notes:
1) All 28 latent vessels are removed (at $2 million each). A total 92 vessels are out with 110,618 m³.
2) Assumes a 20-year buyback loan at 10% interest per year is repaid with an annual payment calculated as a percentage tax on ex-vessel value.
Buyback that Eliminates Closure Periods assuming a $2 million Minimum Bid

Total Buyback Cost is $215 Million

<table>
<thead>
<tr>
<th>Remove Enough Capacity to Completely Eliminate Closure Days</th>
<th>FAD Vessels</th>
<th>Dolphin Vessels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Vessels Removed</td>
<td>28</td>
<td>36</td>
</tr>
<tr>
<td>Number of Active Vessels Remaining</td>
<td>129</td>
<td>50</td>
</tr>
<tr>
<td>Vessel Capacity Removed (m³)</td>
<td>44,627</td>
<td>51,813</td>
</tr>
<tr>
<td>Vessel Capacity Remaining (m³)</td>
<td>109,358</td>
<td>63,829</td>
</tr>
<tr>
<td>Average Capacity (m³) per Remaining Vessel</td>
<td>848</td>
<td>1,277</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Revenues and NOR After the Buyback but Accounting for the Cost of the Buyback</th>
<th>FAD Vessels</th>
<th>Dolphin Vessels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Total Vessel Revenue as a % of SQ Revenue</td>
<td>105.7%</td>
<td>76.4%</td>
</tr>
<tr>
<td>Estimated Revenue per Active Vessel as a % of SQ</td>
<td>120.8%</td>
<td>120.9%</td>
</tr>
<tr>
<td>Net Operating Revenue Gain per Active Vessel from additional harvests due to closure period reductions</td>
<td>$462,358</td>
<td>$350,301</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fleetwide Average Buyback Fees and Dolphin Vessel NOR After Deducting Fleetwide Average Buyback Fees</th>
<th>FAD Vessels</th>
<th>Dolphin Vessels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default Average Payment per Active Vessel (All Types)</td>
<td>$96,185</td>
<td>$141,610</td>
</tr>
<tr>
<td>NOR Gains per Active Vessel After Deducting Average Buyback Fee</td>
<td>$366,173</td>
<td>$208,691</td>
</tr>
<tr>
<td>Ratio of Annual NOR gains Less Fee to Annual Fee</td>
<td>3.81</td>
<td>1.47</td>
</tr>
</tbody>
</table>

Notes:
1) All 28 latent vessels are removed (at $2 million each). A total 92 vessels are out with 110,618 m³.
2) Assumes a 20-year buyback loan at 10% interest per year is repaid with an annual payment calculated as a percentage tax on ex-vessel value.
Additional Harvest Days by Species

- Additional BET Days
- Additional YFT Days
- 62 Closure Days

Capacity Removed with a Buyback under Scenario 2
Additional Harvest Days by Species

Mix of DV & FV Removed

Capacity Removed with a Buyback under Scenario 2
Additional Harvest Days by Species

Mainly DV Removed

Capacity Removed with a Buyback under Scenario 2
Additional Harvest Days by Species

Latent Vessels Removed

Capacity Removed with a Buyback under Scenario 2

Latent Vessels Removed with a Buyback under Scenario 2

62 Closure Days

Additional BET Days

Additional YFT Days

Northern Economics
Additional Harvest Days by Species

Mainly DV with a few FV

- Additional BET Days
- Additional YFT Days
- 62 Closure Days
Additional Harvest Days by Species

Additional Days to Attain SQ Harvest

Capacity Removed with a Buyback under Scenario 2

Select the FVs, not the DVs
Buyback Optimization

• Once YFT closure period reduction approaches 62 days, instruct the Buyback Entity to only buy back latent vessels or FAD Vessels.

• This will reduce costs of the buyback and allow the remaining fleet to harvest a greater portion of the available yellowfin.

• Alternatively, authorize the Buyback Entity to intentionally switch between buying back Dolphin vessels and FAD vessels.

• Force the two dotted lines in the previous figure to track one another.

• Optimization could reduce the cost of the buyback by more than $40 million—a 20 percent reduction.
Buyback Optimization

• Once YFT closure period reduction approaches 62 days, instruct the Buyback Entity, to only buy back latent vessels or FAD Vessels.

• Alternatively, authorize the Buyback Entity to intentionally switch between buying back Dolphin vessels and FAD vessels.

• Force the two dotted lines in the previous figure to track one another.

• Optimization could reduce the cost of the buyback by more than $40 million—a 20 percent reduction.
Buyback Optimization

- Once YFT closure period reduction approaches 62 days, instruct the Buyback Entity, to only buy back latent vessels or FAD Vessels.

- This will reduce costs of the buyback and allow the remaining fleet to harvest a greater portion of the available yellowfin.
Buyback Optimization

- Once YFT closure period reduction approaches 62 days, instruct the Buyback Entity, to only buy back latent vessels or FAD Vessels.

- This will reduce costs of the buyback and allow the remaining fleet to harvest a greater portion of the available yellowfin.

- Alternatively, authorize the Buyback Entity to intentionally switch between buying-back Dolphin vessels and FAD vessels.
Buyback Optimization

- Once YFT closure period reduction approaches 62 days, instruct the Buyback Entity, to only buy back latent vessels or FAD Vessels.

- This will reduce costs of the buyback and allow the remaining fleet to harvest a greater portion of the available yellowfin.

- Alternatively, authorize the Buyback Entity to intentionally switch between buying-back Dolphin vessels and FAD vessels
  - Force the two dotted lines in the previous figure to track one another.
Buyback Optimization

• Once YFT closure period reduction approaches 62 days, instruct the Buyback Entity, to only buy back latent vessels or FAD Vessels.

• This will reduce costs of the buyback and allow the remaining fleet to harvest a greater portion of the available yellowfin.

• Alternatively, authorize the Buyback Entity to intentionally switch between buying-back Dolphin vessels and FAD vessels
  • Force the two dotted lines in the previous figure to track one another.

• Optimization could reduce the cost of the buyback by more than $40 million—a 20 percent reduction.
Thank you for your Attention

- NEI is happy to answer any questions you have
- Feel free to contact us by email or by telephone
- Marcus Hartley; marcus.hartley@norecon.com
  +1 907 274 5600