NOAA FISHERIES

Programmatic Environmental Assessment for the Implementation of Decisions of the Western and Central Pacific Fisheries Commission on Management of Tropical Tunas in the Western and Central Pacific Ocean from 2015-2020

Prepared by:
National Marine Fisheries Service
Pacific Islands Regional Office

Contact Information:
Regional Administrator
NMFS Pacific Islands Regional Office
attn: International Fisheries Division
1845 Wasp Boulevard, Building 176
Honolulu, HI 96818

Tel: (808) 725-5000
Fax: (808) 725-5215
E-mail: pirohonolulu@noaa.gov
Website: http://www.fpir.noaa.gov/

July 2015

List of Abbreviations and Acronyms

CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMM	Conservation and Management Measure
CNMI	Commonwealth of the Northern Mariana Islands
CPUE	Catch per Unit of Effort
Convention	Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean
Convention Area	Area of Application of the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean
CY	Calendar Year
DPS	Distinct Population Segment
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
ELAPS	Effort Limit Area for Purse Seine
ENSO	El Niño – Southern Oscillation
EPO	Eastern Pacific Ocean
ESA	Endangered Species Act
FAD	Fish Aggregating Device
FEP	Fishery Ecosystem Plan
FFA	Forum Fisheries Agency
FMP	Fishery Management Plan
FR	*Federal Register*
HAPC	Habitat Areas of Particular Concern
HMS	Highly Migratory Species
HSFCA	High Seas Fishing Compliance Act
IATTC	Inter-American Tropical Tuna Commission
MMPA	Marine Mammal Protection Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
mt	Metric ton
NAO	NOAA Administrative Order
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWR	National Wildlife Refuge
NWS	National Weather Service
NWSAA	National Wildlife System Administration Act of 1966
OFP	Oceanic Fisheries Programme
PEA	Programmatic Environmental Assessment
Pelagics FEP	Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region
PIPA	Phoenix Islands Protected Area
PIC	Pacific Island Countries

PNA	Parties to the Nauru Agreement
PRIA	Pacific Remote Island Areas.
RIR	Regulatory Impact Review
SPC	Secretariat of the Pacific Community
SPTA	South Pacific Tuna Act of 1988
SPTT or Treaty	South Pacific Tuna Treaty (formally, the Treaty on Fisheries between the Governments of Certain Pacific Island States and the Government of the United States of America)
SST	Sea Surface Temperature
USFWS	United States Fish and Wildlife Service
VMS	Vessel Monitoring System
WCPFC	Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean, also known as the Western and Central Pacific Fisheries Commission
WCPFCIA	Western and Central Pacific Fisheries Convention Implementation Act
West Coast HMS FMP	Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species
WCPO	Western and Central Pacific Ocean
WPRFMC	Western Pacific Regional Fishery Management Council

Contents

List of Acronyms……2
Table of Contents……....4
List of Tables……...…8
List of Figures……..9
1 Chapter 1 Introduction and Purpose and Need 9
1.1 Background 10
1.2 NMFS' Previous Domestic Implementation of WCPFC Decisions on Tropical Tunas11
1.2.1 Purse Seine Fisheries 12
1.2.2 Longline Fisheries 12
1.3 Administrative Process 13
1.4 Purpose and Need 13
2 Chapter 2 Proposed Action and Alternatives 15
2.1 Proposed Action 15
2.1.1 Bigeye Tuna Catch Limits in the Longline Fishery 15
2.1.2 Fishing Effort Limits in the Purse Seine Fishery 16
2.1.3 FAD Setting Prohibition Periods in the Purse Seine Fishery 17
2.1.4 FAD Set Limits in the Purse Seine Fishery 17
2.1.5 Total Prohibition Periods in the Purse Seine Fishery 18
2.1.6 High Seas FAD Closures in the Purse Seine Fishery 18
2.1.7 Yellowfin Tuna Catch Limits in the Longline Fishery 18
2.1.8 Yellowfin Tuna Catch Limits in the Purse Seine Fishery 19
2.1.9 Bigeye Tuna Catch Limits in the Purse Seine Fishery 19
2.2 Alternative A: The No-Action Alternative 20
2.3 The Action Alternatives Analyzed in Depth in this PEA 20
2.3.1 Alternative B, Least Restrictive Action Alternative 24
2.3.2 Alternative C, Most Restrictive Action Alternative 24
2.3.3 Alternative D, Most Restrictive FAD Setting Prohibition Period Variation 24
2.3.4 Alternative E, Additional FAD Setting Prohibition Period 24
2.3.5 Alternative F, FAD Set Limit Variation 24
2.3.6 Alternative G, Total Purse Seine Closure Variation 24
2.3.7 Alternative H, Most Restrictive Without High Seas FAD Closure 25
2.3.8 Alternative I, Variation on Purse Seine Fishing Effort Limits 25
2.3.9 Alternative J, Variation on Purse Seine Fishing Effort Limits, Separate Areas 25
2.3.10 Alternative K, Multiyear Limits 25
2.4 Alternatives Excluded from Detailed Analyses 25
3 Chapter 3 Affected Environment 26
3.1 Physical Environment of the WCPO 26
3.1.1 Oceanography 26
3.1.2 Climate Change 30
3.1.3 Habitat Change 31
3.2 U.S. WCPO Purse Seine Fishery 31
3.2.1 Fleet Characteristics 32
3.2.2 Management of the U.S. Purse Seine Fleet in the WCPO 33
3.2.3 Participation, Effort, and Catch 35

3.2.4 FADs ... 38
3.2.5 Economics ... 42
3.3 WCPO Longline Fisheries ... 43
3.3.1 Hawaii-Based Deep-Set and Shallow-Set Longline Fisheries ... 43
3.3.2 American Samoa Longline Fishery ... 50
3.4 Convention Area HMS Fisheries ... 52
3.5 Target Species ... 53
3.5.1 Albacore *(Thunnus alalunga*) ... 53
3.5.2 Bigeye Tuna (*Thunnus obesus*) ... 55
3.5.3 Skipjack Tuna *(Katsuwonus pelamis)* ... 57
3.5.4 Swordfish (*Xiphias gladius*) ... 59
3.5.5 Yellowfin Tuna (*Thunnus albacares*) ... 60
3.6 Non Target Species ... 62
3.7 Biological Environment ... 67
3.7.1 Trophic Levels ... 67
3.8 Protected Resources ... 70
3.8.1 Marine Mammals ... 73
3.8.2 Essential Fish Habitat ... 75
3.8.3 National Wildlife Refuges (NWRs) and Monuments ... 76
Chapter 4 Environmental Consequences: Direct and Indirect Effects ... 78
4.1 The U.S. WCPO Purse Seine Fishery ... 78
4.1.1 Alternative A: The No-Action Alternative ... 78
4.1.2 Alternative B: Least Restrictive Action Alternative ... 79
4.1.3 Alternative C, Most Restrictive Action Alternative ... 84
4.1.4 Alternative D, Most Restrictive FAD setting prohibition Period Variation ... 92
4.1.5 Alternative E, Additional FAD Setting Prohibition Period ... 92
4.1.6 Alternative F, FAD Set Limit Variation ... 93
4.1.7 Alternative G, Total Purse Seine Closure Variation ... 94
4.1.8 Alternative H, Most Restrictive Without High Seas FAD Closure ... 96
4.1.9 Alternative I, Variation on Purse Seine Fishing Effort Limits ... 96
4.1.10 Alternative J, Variation on Purse Seine Fishing Effort Limits, Separate Areas ... 98
4.1.11 Alternative K, Multiyear Limits ... 100
4.2 The Hawaii-Based Deep-Set and Shallow-Set Longline Fisheries ... 101
4.2.1 Alternative A, the No-Action Alternative ... 101
4.2.2 Alternative B, Least Restrictive Action Alternative ... 102
4.2.3 Alternative C, Most Restrictive Action Alternative ... 105
4.2.4 Alternative D and Alternative H ... 105
4.2.5 Alternative E, Alternative F, Alternative G, Alternative I, and Alternative J ... 106
4.2.6 Alternative K, Multiyear Limits ... 106
4.3 Longline fisheries of the U.S. Participating Territories ... 106
4.4 Physical Environment and Climate Change ... 106
4.5 Bigeye Tuna, Skipjack Tuna, and Yellowfin Tuna ... 107
4.5.1 Alternative A, the No-Action Alternative ... 107
4.5.2 Alternative B, Least Restrictive Action Alternative ... 108
4.5.3 Alternative C, Most Restrictive Action Alternative ... 109
4.5.4 Alternative D, Most Restrictive FAD Setting Prohibition Period Variation ... 110

4.5.5 Alternative E, Additional FAD Setting Prohibition Period 111
4.5.6 Alternative F, FAD Set Limit Variation 112
4.5.7 Alternative G, Total Purse Seine Closure Variation 112
4.5.8 Alternative H, Most Restrictive Without High Seas FAD Closure 113
4.5.9 Alternative I, Variation on Purse Seine Fishing Effort Limits 113
4.5.10 Alternative J, Variation on Purse Seine Fishing Effort Limits, Separate Areas ... 114
4.5.11 Alternative K, Multiyear Limits 114
4.6 Other Target Fish Species 115
4.6.1 Alternative A, No-Action Alternative 115
4.6.2 Action Alternatives 115
4.7 Non-Target Fish Species 116
4.7.1 Alternative A, No-Action Alternative 116
4.7.2 Action Alternatives 116
4.8 Protected Resources 117
4.8.1 Alternative A, No-Action Alternative 117
4.8.2 Action Alternatives, the U.S. WCPO Purse Seine Fishery 117
4.8.3 Action Alternatives, the Hawaii-Based Longline Fisheries 119
4.9 Environmental Justice 120
4.10 Comparison of Alternatives 120
5 Chapter 5 Cumulative Impacts 123
5.1 Affected Environment 123
5.2 Past, Present, and Reasonably Foreseeable Future Actions 123
5.2.1 Past Actions 124
5.2.2 Other Present Actions 125
5.2.3 Reasonably Foreseeable Future Actions 125
5.3 Discussion of Cumulative Impacts 125
5.3.1 Cumulative Impacts to Physical Resources and Climate Change 126
5.3.2 Cumulative Impacts to Bigeye, Skipjack, and Yellowfin Tuna in the WCPO 126
5.3.3 Cumulative Impacts to Other Target or Non-target Fish Species in the WCPO .. 127
5.3.4 Cumulative Impacts to Protected Resources in the WCPO 127
5.3.5 Cumulative Impacts to Environmental Justice 127
6 Consultation 128
7 Literature Cited 129

Appendix A – Categorical Exclusion for the Establishment of a Framework Process to Implement Decisions of the Western and Central Pacific Fisheries Commission

List of Tables

Table 1: Table of Action Alternatives. 21
Table 2: U.S. WCPO purse seine fleet fishing effort (1997-2013) in the Convention Area. 36
Table 3: Retained catch of the U.S. purse seine fishery in the Convention Area, 1997-2013..... 37
Table 4: Annual U.S. WCPO purse seine catch estimates in metric tons by set type (unassociated and associated), 2003-2012 (data for 2012 are preliminary) 38
Table 5: Total sets, FAD sets, and fishing days in the U.S. WCPO purse seine fishery, 2010-2013..... 41
Table 6: Total sets and FAD sets in the U.S. EEZ, on the high seas and in EEZs of other PICs, 1997-2013. 42
Table 7: Per vessel economics of the U.S. purse seine fleet based in American Samoa in 1998 (1998 dollars) 43
Table 8: Hawaii-based deep set longline fishery performance factors in the WCPFC area, 2000-2014..... 46
Table 9: Hawaii-based shallow set longline fishery performance factors in the WCPFC area, 2000-2014 47
Table 10: American Samoa-based longline fishery performance factors in the Convention Area, 2000-2014. 52
Table 11: Stock status summary of main target HMS for U.S. longline fleets in the Pacific Ocean 53
Table 12: Observed Estimates of Catch and Rate of Discards of “Other” Fish Species in 2010 by the U.S. WCPO Purse Seine Fleet. 62
Table 13: Hawaii-based deep-set longline fishery landings and discards of non-target species .. 64
Table 14: Hawaii-based shallow-set longline fishery landings and discards of non-target species 66
Table 15: American Samoa based longline fishery landings and discards of non-target species. 66
Table 16: Listing status of species in the WCPO listed as endangered or threatened under the U.S. Endangered Species Act 70
Table 17: Non-ESA listed marine mammals that occur in the WCPO..... 73
Table 18: EFH and HAPC for species managed under the pelagics, crustaceans, bottomfish and seamount groundfish, precious corals, crustaceans, and coral reef ecosystems, western Pacific FMPs 76
Table 19: Comparison of Alternatives 120
Table 20: List of agencies and offices contacted 128

List of Figures

Figure 1: The Convention Area 11
Figure 2: Main currents of the Pacific Ocean 27
Figure 3: The general operational area of the U.S. WCPO purse seine fishery 32
Figure 4 Distribution of U.S. purse seine effort during 2001 and 2002 38
Figure 5: FAD sets as proportion of all sets by U.S. WCPO purse seine fleet, 1997-2013. 39
Figure 6: FAD sets as proportion of all sets by U.S. WCPO purse seine fleet, by month, 1997-2008 average, 2009, 2010-2012 average and 2013..... 40
Figure 7: Proportion of the WCPO U.S. purse seine fleet that fished, by month, 1997-2013..... 41
Figure 8: Schematic Diagram of Longline Fishing in Hawaii. 44
Figure 9: Estimates of bigeye tuna kept in the U.S. longline fisheries, WCPO only, deep-set and shallow-set, cumulative by month, 2005-2014. 48
Figure 10: Estimates of bigeye tuna kept in the U.S. longline fisheries, WCPO only, shallow-set only, cumulative by month, 2005-2014. 49
Figure 11: Estimates of swordfish kept in U.S. shallow-set longline fishery, WCPO only, cumulative by month, 2005-2014. 49
Figure 12: Convention Area albacore catch (mt) by gear 1972-2013.. 55
Figure 13: Convention Area bigeye tuna catch (mt) by gear 1960-2013 57
Figure 14: Convention Area skipjack tuna catch (mt) by gear 1960-2013..... 58
Figure 15: South Pacific longline swordfish catch (mt) by fleet 1972-2013..... 60
Figure 16: Convention Area yellowfin tuna catch (mt) by gear type 1960-2013..... 62
Figure 17: Trophic diagram of the central Pacific Ocean..... 68

Chapter 1 Introduction and Purpose and Need

The National Marine Fisheries Service (NMFS) has prepared this Programmatic Environmental Assessment (PEA) pursuant to the National Environmental Policy Act (NEPA; 42 U.S.C. § 4321, *et seq*.) and related authorities, such as the Council on Environmental Quality's (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations (CFR) Parts 1500-1508) and the National Oceanic and Atmospheric Administration's (NOAA) Environmental Review Procedures for Implementing NEPA (NOAA Administrative Order (NAO) 216-6).

At its 11th Regular Session, in December 2014, the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (Commission or WCPFC) adopted Conservation and Management Measure (CMM) 2014-01, "Conservation and Management Measure for Bigeye, Yellowfin and Skipjack Tuna in the Western and Central Pacific Ocean." CMM 2014-01 is generally applicable for the 2015-2017 calendar year period, and only contains minor modifications to CMM 2013-01, the predecessor CMM for the three main tropical tunas (skipjack tuna (*Katsuwonus pelamis)*, yellowfin tuna (*Thunnus albacares)*, and bigeye tuna (*Thunnus obesus*)). CMM 2014-01 includes provisions for purse seine vessels and longline vessels. The CMM's provisions for purse seine vessels include limits on the allowable level of fishing effort, restrictions on the use of fish aggregating devices (FADs), and a general provision not to increase catches of yellowfin tuna. The CMM's provisions for longline vessels include catch limits for bigeye tuna and a general provision not to increase catches of yellowfin tuna.

Based on the Commission's CMMs on tropical tunas from 2008 through 2014,[1] NMFS believes that the Commission has established a general pattern of management for tropical tunas and that provisions similar or identical to the provisions in CMM 2014-01 will likely be adopted by the Commission for the reasonably foreseeable future, which, for the purposes of this document is through the end of 2020.[2] NMFS believes that a broad programmatic approach to analyzing NMFS' domestic implementation of the Commission's CMMs on tropical tunas in the western and central Pacific Ocean (WCPO) is appropriate, as it would help inform the public and provide timely analyses about upcoming agency actions as far in advance as possible. This PEA analyzes NMFS' projected domestic implementation of the Commission's conservation and management measures on tropical tunas in the WCPO, pursuant to the Western and Central Pacific Fisheries Convention Implementation Act (WCPFCIA; 16 USC 6901 *et seq*.), from 2015 through the end of 2020. NMFS notes that specific agency actions may be subject to change, as the Commission may adopt new or different measures not within the scope of this PEA and the range of alternatives analyzed in this PEA in no way prejudices positions that the United States may take during futureWCPFC meetings. In the event future measures are outside the scope of the alternatives analyzed in this EA those measures will be subject to additional NEPA analysis.

[1] See CMM 2008-01, CMM 2011-01, CMM 2012-01, CMM 2013-01 and CMM 2014-01, available on the WCPFC Web site at https://www.wcpfc.int/.

[2] NMFS has chosen 2015 through the end of 2020 as the timeframe for analysis in this PEA, because generally NEPA analyses more than five years old need to be reexamined to determine whether supplemental information is needed (see CEQ 1981).

1.1 ***Background***

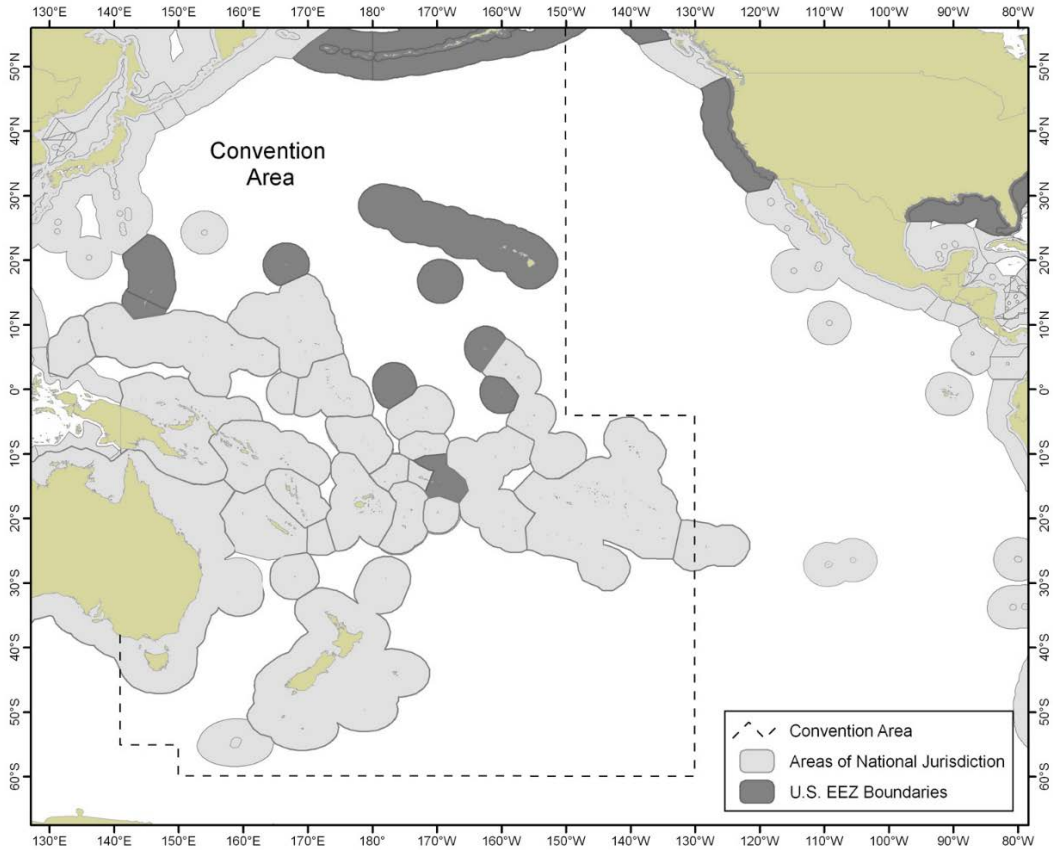
The United States ratified the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (Convention) in 2007.[3] The area of application of the Convention (Convention Area), which encompasses the WCPO, is shown in Figure 1.

The Convention text indicates that the agreement is focused on highly migratory fish species (HMS) and stocks thereof within the Convention Area (see the Convention text for the specific HMS covered).[4] The Convention provides for the conservation and management of target stocks, non-target species, and species belonging to the same ecosystem or dependent upon or associated with the target stocks.

[3] The Convention was opened for signature in Honolulu on September 5, 2000, and entered into force in June 2004; the Convention entered into force for the United States in 2007. The full text of the Convention is available at: http://www.wcpfc.int/key-documents/convention-text.

[4] Though not specifically stated in the Convention text, it has also been agreed that southern bluefin tuna (*Thunnus maccoyii*) that are found in the Convention Area will continue to be solely managed by the Commission for the Conservation of Southern Bluefin Tuna.

Figure 1: The Convention Area (high seas in white; U.S. Exclusive Economic Zone in dark gray; foreign jurisdictions in light gray)



Source: NMFS.

The Commission as an intergovernmental body – among other things – adopts CMMs that Commission Members, Cooperating Non-Members, and Participating Territories (collectively referred to as WCPFC members) are obligated to implement through their respective national laws and procedures. The WCPFCIA authorizes the Secretary of Commerce, in consultation with the Secretary of State and the Secretary of the Department in which the Coast Guard is operating, to develop such regulations as are needed to carry out the obligations of the United States under the Convention. The authority to promulgate regulations to implement the provisions of the Convention and WCPFC decisions, such as regulations to implement CMMs, has been delegated by the Secretary of Commerce to NMFS.

1.2 *NMFS' Previous Domestic Implementation of WCPFC Decisions on Tropical Tunas*

Earlier WCPFC CMMs for tropical tuna management, which contained provisions for longline and purse seine fisheries and which NMFS implemented via rulemaking, include CMM 2008-01, "Conservation and Management Measure for Bigeye and Yellowfin Tuna in the Western and Central Pacific Ocean," CMM 2011-01, "Conservation and Management Measure for temporary extension of CMM 2008-01," CMM 2012-01, "Conservation and Management Measure for

Bigeye, Yellowfin and Skipjack Tuna in the Western and Central Pacific Ocean" and CMM 2013-01, "Conservation and Management Measure for Bigeye, Yellowfin and Skipjack Tuna in the Western and Central Pacific Ocean."

1.2.1 **Purse Seine Fisheries**

CMM 2008-01 set forth specific provisions for purse seine fisheries for the years 2009, 2010, and 2011, which NMFS implemented in 2009 (see final rule published August 4, 2009, at 74 *Federal Register* (FR) 38544). The regulations included specific fishing effort limits, in fishing days, for the high seas and for the U.S. Exclusive Economic Zone (EEZ), restrictions on the use of FADs, high seas area closures, catch retention requirements, and specific observer coverage requirements. Due to a change in meeting schedule, in December 2011, the Commission adopted an intersessional decision to extend the provisions of CMM 2008-01 until the Commission met in March 2012. NMFS implemented that intersessional decision for the U.S. purse seine fleet operating in the WCPO through an interim rule in 2011 (see interim rule published December 30, 2011, at 76 FR 82180). Adopted in March 2012, CMM 2011-01 extended the majority of the provisions of CMM 2008-01 through the end of 2012. Given that the 2011 rule extended the applicable provisions of CMM 2011-01 for the U.S. purse seine fleet through 2012, there was no need for NMFS to take additional regulatory action to put into place the measures of CMM 2011-01 for purse seine fisheries.

NMFS implemented the purse seine provisions of CMM 2012-01 for 2013 and 2014 in 2013 (see final rule published May 23, 2013, at 78 FR 30773). The regulations included specific fishing effort limits, restrictions on the use of FADs, and specific observer coverage requirements. CMM 2013-01 contained modifications to the fishing effort limits for 2014, which NMFS implemented in 2014 (see final rule published November 13, 2014, at 79 FR 67359).

CMM 2013-01 contained provisions for restrictions on the use of FADs, some of which were subject to further consideration by the Commission. Given that some of the restrictions could have applied starting on January 1, 2015, pending the resolution of an issue related to the equity of burdens resulting from implementing WCPFC CMMs, NMFS implemented the majority of the FAD restrictions for 2015 in 2014 (see final rule published December 2, 2014, at 79 FR 71327). NMFS is implementing the remaining FAD restrictions for 2015 (which are now prescribed in CMM 2014-01, which replaced CMM 2013-01) as part of the proposed action analyzed in this PEA, as described further in Chapter 2 of this document.

NMFS also implemented the purse seine fishing effort limits for 2015 in an interim rule (see interim rule published May 21, 2015, at 80 FR 29220) to ensure that the limits went into effect before the prescribed limits were exceeded by the fleet.

1.2.2 **Longline Fisheries**

CMM 2008-01 set forth specific bigeye tuna catch limits for the U.S. longline fisheries operating in the WCPO for 2009, 2010, and 2011. NMFS implemented these catch limits in 2009 (see final rule published December 7, 2009, at 74 FR 63999). CMM 2011-01 also set forth bigeye tuna catch limits for 2012, which NMFS implemented in 2012 (see interim final rule published

August 27, 2012, at 77 FR 51709). CMM 2012-01 set forth bigeye tuna catch limits for 2013, which in 2013 NMFS implemented for 2013 and 2014, anticipating that the limit would likely remain the same in 2014 (see final rule published September 23, 2013, at 78 FR 58240). The bigeye tuna catch limits for U.S. longline fisheries from 2009 through 2014 were 3,763 metric tons (mt) per calendar year.

1.3 *Administrative Process*

NMFS intends to implement the Commission's conservation and management measures on bigeye tuna, yellowfin tuna, and skipjack tuna from 2015 through the end 2020 via rulemakings under the WCPFCIA, similar to the rulemakings described in Section 1.2. NMFS may implement the WCPFC provisions through specific regulations, as in the past. However, NMFS is also proposing to establish a framework process through which NMFS can in a timely and administratively efficient manner implement WCPFC decisions for tropical tunas and other WCPFC decisions for HMS, pursuant to the authority of the WCPFCIA. Under the proposed framework process, NMFS could specify limits on fishing effort and catches, as well as spatial and/or temporal restrictions on particular fishing activities, in U.S. fisheries for HMS in the WCPO. NMFS has determined that the establishment of the proposed framework process qualifies to be categorically excluded from further NEPA review (see Appendix A of this document), and thus, the framework process is not part of the proposed action analyzed in this PEA.[5]

NMFS also notes that under the WCPFCIA, in cases where there is discretion in the implementation of one or more measures adopted by the Commission that would govern fisheries under authority of a Regional Fishery Management Council, NMFS may, to the extent practicable within the implementation schedule of the Convention and any recommendations and decisions adopted by the Commission, promulgate such regulations in accordance with the procedures established by the Magnuson-Stevens Fishery Conservation and Management Act (MSA; 16 U.S.C. 1801 *et seq*.).

1.4 *Purpose and Need*

The purpose of NMFS' domestic implementation of WCPFC decisions on tropical tunas from 2015 to 2020 is to contribute to the underlying objectives of the Commission's management of tropical tuna stocks in the WCPO, which, as stated in CMM 2014-01, are to reduce or maintain their respective fishing mortality rates at levels no greater than those rates associated with

[5] The establishment of the proposed framework is part of a rulemaking that includes establishment of the framework as well as several other unrelated regulatory matters that are the subject of a separate categorical exclusion document. As part of the same rulemaking, NMFS is also proposing to specify certain limits regarding tropical tunas for the U.S. purse seine fisheries operating in the WCPO. These limits are part of the proposed action and are within the range of alternatives analyzed in this PEA.

maximum sustainable yield, and as reflected in the Commission's limit reference points for these stocks, are to avoid the spawning stocks becoming smaller than 20 percent of the estimated spawning stock size in the absence of fishing. The need for the domestic implementation of WCPFC decisions on tropical tunas is to satisfy the obligations of the United States as a Contracting Party to the Convention, pursuant to the authority of the WCPFCIA.

Chapter 2 Proposed Action and Alternatives

In an environmental review document, agencies must assess the environmental impacts of a proposal and reasonable and feasible alternatives to the proposal in comparative form. The purpose of this comparison of alternatives is to provide the decision maker and the public with a clear basis for choosing among the alternatives.[6]

This chapter provides a description of the proposed action analyzed in this PEA and the alternative means of implementing the proposed action. The chapter also includes a description of the No-Action Alternative (i.e., the existing conditions and the conditions that would result if the proposed action were not implemented under any of the action alternatives).

2.1 *Proposed Action*

The proposed action is NMFS' domestic implementation of the Commission's conservation and management measures, pursuant to the WCPFCIA, on the "tropical tunas" or bigeye tuna, yellowfin tuna, and skipjack tuna from 2015 through the end of 2020. This section details each of the elements of the proposed action and options for implementing each of the elements. The options for each of the elements are then combined into discrete alternatives for analyses, which are described in Section 2.3 of this PEA. As described in Chapter 3, skipjack tuna is caught primarily in purse seine fisheries in the WCPO, and thus, rather than specific catch limits, the purse seine fishing effort limits, FAD restrictions and other purse seine prohibitions would manage skipjack tuna catch. These are the types of management measures for skipjack tuna specified in CMM 2014-01.

2.1.1 **Bigeye Tuna Catch Limits in the Longline Fishery**

As described in Section 1.2.2 of this PEA, NMFS implemented longline bigeye tuna catch limits of 3,763 mt per calendar year for the U.S. longline fleets operating in the WCPO from 2008 through 2014. CMM 2014-01 specifies that the longline bigeye tuna catch limits for the U.S. longline fishery in the Convention Area are to be reduced to 3,554 mt for 2015 and 2016 and 3,345 for 2017, and may include additional reduction that would be less any overage in the preceding year. To determine these numbers the Commission used the 2004 U.S. bigeye tuna longline catch (4,181 mt) as the baseline from which the catch limits were calculated. Based on these numbers, NMFS has identified the following as a reasonable range of options for this element of the proposed action, each of which would apply throughout the Convention Area:

1) A limit of 3,554 mt in 2015, followed by 5,000 mt per year through 2020.
2) A limit of 2,090 mt per year (50% of the 2004 catch) from 2015 through 2020, or a 50% reduction from the baseline, which would likely be the lowest reduction of bigeye tuna catch prescribed by the Commission in the reasonably foreseeable future.

[6] See the CEQ's Regulations for Implementing the Procedural Provisions of NEPA at 40 CFR §1502.14.

2.1.2 **Fishing Effort Limits in the Purse Seine Fishery**

NMFS implemented fishing effort limits in terms of fishing days for the U.S. purse fleet from 2009 through 2014. The limits applied to the high seas and the U.S. EEZ within the Convention Area, between the latitudes of 20° N. and 20° S., an area referred to in U.S. fisheries regulations as the Effort Limit Area for Purse Seine, or ELAPS. The limits for the ELAPS for 2009-2012 were 7,764 fishing days for the three-year periods 2009-2011 and 2010-2012, 6,470 fishing days for each of the two-year periods 2009-2010, 2010-2011, and 2011-12 and 3,882 fishing days for each of the one-year periods 2009, 2010, 2011, and 2012. The limit for 2013 was 2,588 fishing days, and the limit for 2014 was 1,828 fishing days (the differences were based on WCPFC mandated reductions). CMM 2014-01 specifies that the effort limit in the U.S. EEZ should reflect the geographical distributions of skipjack tuna, yellowfin tuna, and bigeye tuna and that are consistent with the CMM's objectives for those species. It further states, that coastal States that have already notified limits to the Commission shall restrict purse seine fishing effort and/or catches within their EEZs in accordance with those limits. The limit that the United States has notified to the Commission for the U.S. EEZ is 558 days. CMM 2014-01 specifies that the effort limit for the U.S. purse seine fleet on the high seas for 2015 should be 1,270 fishing days. Based on these numbers, NMFS has identified the following as a reasonable range of options for this element of the proposed action, each of which would apply in the Convention Area between the latitudes of 20° N. and 20° S.[7]:

1) Separate annual limits of 432 fishing days on the high seas and 25 fishing days in the U.S. EEZ for each of the years 2015-2020. These numbers are based on the lowest per-vessel effort levels in the 1997-2013 period (which occurred in 2010), adjusted for a maximum of 40 vessels fleet, which is the maximum number of vessel licenses currently authorized.
2) Separate annual limits of 1,270 fishing days on the high seas and 558 fishing days in the U.S. EEZ, which is the same total number of fishing days implemented in the effort limit for the ELAPS for 2014, but separated into separate limits for the two portions of the ELAPS.
3) A combined annual limit of 1,828 fishing days in the ELAPS, which is identical to the effort limit for 2014 and 2015.
4) A combined annual limit of 3,898 fishing days in the ELAPS. This number is based on the highest per-vessel effort levels on the high seas and in the U.S. EEZ in the 1997-2010

[7] NMFS has implemented the 2015 purse seine fishing effort limit in the ELAPS of 1,828 fishing days via an interim final rule (see 80 FR 29220, published May 21, 2015). NMFS implemented this fishing effort separately from other provisions of the CMM for 2015 to ensure that the limit went into effect in U.S. regulations before the prescribed limit was exceeded by the fleet. However, given the scope of this document, analysis of the 2015 purse seine fishing effort limit for the ELAPS is included in this PEA. NMFS prepared a separate Environmental Assessment (EA) for the rule to implement the 2015 purse seine fishing effort limit in the ELAPS (*Environmental Assessment for a Rule to Implement Decisions of the Western and Central Pacific Fisheries Commission for: Fishing Effort Limits in Purse Seine Fisheries for 2015* available at www.regulations.gov by searching for docket ID NOAA-NMFS-2015-0058-0001) and this PEA incorporates that EA by reference. Relevant sections are explicitly referenced, as appropriate. NMFS has closed the fishery in the ELAPS from June 15, 2015 through the end of the calendar year (see 80 FR 32313, published June 8, 2015).

period (which occurred in 2005 for the high seas and in 1997 for the U.S. EEZ), summed and adjusted for a maximum of 40 vessels in the fleet.

2.1.3 FAD Setting Prohibition Periods in the Purse Seine Fishery

NMFS implemented FAD setting prohibition periods for the U.S. purse seine fleet from 2009-2015. The prohibition periods were in August and September in 2009, July through September in 2010-2012, and July through October in 2013 and 2014. CMM 2014-01 specifies a three-month FAD setting prohibition period for 2015 through 2017. In addition to this three-month FAD setting prohibition period, in 2015, the United States must implement either an additional month of the FAD setting prohibition period or limit the total number of purse seine sets on FADs ("FAD sets") to 2,522 sets per year. For 2016, the United States must either implement an additional two-month FAD setting prohibition period and limit the total number of FAD sets to 3,061 sets per year, or limit the total number of FAD sets to 2,522 sets, if the Commission agrees that implementing the additional measures does not have a disproportionate burden on small island developing States.[8] NMFS has identified the following as a reasonable range of options for this element of the proposed action, each of which would apply in the Convention Area between the latitudes of 20° N. and 20° S.:

1) A FAD setting prohibition period of three months (e.g., July through September) in each of the years 2015 through 2020.
2) A FAD setting prohibition period of four months (e.g., July through October) in each of the years 2015 through 2020.
3) A FAD setting prohibition period for the full year in each of the years 2015 through 2020.

2.1.4 FAD Set Limits in the Purse Seine Fishery

As described in Section 2.1.3, CMM 2014-01 specifies that as an alternative to FAD setting prohibition periods longer than three months, WCPFC members may, in addition to establishing three-month FAD setting prohibition periods, limit the total number of FAD sets to specific numbers each year. Based on these provisions, NMFS has identified the following as a reasonable range of options for this element of the proposed action, each of which would apply in the Convention Area between the latitudes of 20° N. and 20° S.:

1) A limit of 2,522 FAD sets per year in each of the years 2015 through 2020 (see Attachment A of CMM 2014-01).

[8] NMFS has already implemented a FAD setting prohibition period for July through September for 2015 through a separate rulemaking (see 79 FR 71327; published December 2, 2014). However, as additional FAD restrictions likely would be implemented in 2015, in order to analyze the effects of FAD restritions for 2015, NMFS is considering all FAD restrictions in 2015, including the July through September FAD setting prohibition period, as part of the proposed action. NMFS prepared a supplemental EA for the July through September 2015 FAD setting prohibition period (*Supplemental Environmental Assessment for a Rule to Implement Decisions of the Western and Central Pacific Fisheries Commission for: Restrictions on the Use of Fish Aggregating Devices in Purse Seine Fisheries for 2015* available at www.regulations.gov by searching for NOAA-NMFS-2014-0115) and this PEA incorporates that supplemental EA by reference. Relevant sections are explicitly referenced, as appropriate.
.

2) A limit of 3,061 FAD sets per year in each of the years 2015 through 2020 (see Attachment A of CMM 2014-01).
3) A limit of 1,530 FAD sets per year in each of the years 2015 through 2020, which is 50 percent of the U.S. fleet's 2010-2012 average, the baseline period used to calculate the FAD set limits in CMM 2014-01.
4) A complete prohibition on FAD sets in each of the years 2015 through 2020.

2.1.5 Total Prohibition Periods in the Purse Seine Fishery

The Commission has also discussed, though not yet adopted, total closure periods for the purse seine fishery (during which all purse seine fishing, not just FAD-associated purse seine fishing, would be prohibited). NMFS has identified the following as a reasonable range of options for this element of the proposed action, each of which would apply in the Convention Area between the latitudes of 20° N. and 20° S.:

1) A total purse seine closure period of six months in each of the years 2015 through 2020.
2) A total purse seine closure period of three months in each of the years 2015 through 2020.

2.1.6 High Seas FAD Closures in the Purse Seine Fishery

CMM 2014-01 requires that WCPFC members prohibit fishing on FADs on the high seas in 2017, except for Kiribati-flagged vessels fishing in the adjacent high seas, vessels flagged to the Philippines, and vessels flagged to WCPFC members that have achieved a verified reduction in bigeye catches by its purse seine vessels to 55 percent of 2010-2012 levels. Based on this information, NMFS has identified the option for this element of the proposed action which would apply in the Convention Area between the latitudes of 20° N. and 20° S.:

1) Prohibit U.S. purse seine vessels from fishing on FADs on the high seas, between the latitudes of 20° N. and 20° S., in each of the years 2017, 2018, 2019, and 2020.

2.1.7 Yellowfin Tuna Catch Limits in the Longline Fishery

CMM 2014-01 states that WCPFC members agree to take measures not to increase catches by their longline vessels of yellowfin tuna and that the Commission will formulate and adopt appropriate limits for WCPFC members at its 2015 regular session. Based on this information and other Commission decisions, NMFS has identified the following as a reasonable range of options for this element of the proposed action, each of which would apply throughout the Convention Area:

1) A catch limit for each of the years 2015 through 2020 set at the 2012 level of yellowfin tuna catch in the U.S. longline fishery, which was 576 mt (the most recent recommendation of the Commission's Scientific Committee, upon which CMMs 2013-01 and 2014-01 were based, is that WCPO yellowfin tuna catches not be increased from 2012 levels).

2) A catch limit for each of the years 2015 through 2020 of 1,142 mt, the highest annual catch of yellowfin tuna in the U.S. longline fishery from 2001 through 2013.
3) A catch limit for each of the years 2015 through 2020 of 421 mt, 50% of the average annual catch in the U.S. longline fishery in 2001-2004, the period used as the baseline for the longline yellowfin tuna catch limits in CMM 2008-01.

2.1.8 Yellowfin Tuna Catch Limits in the Purse Seine Fishery

CMM 2014-01 states that WCPFC members agree to take measures not to increase catches by their purse seine vessels of yellowfin tuna and that the Commission will formulate and adopt appropriate limits for WCPFC members at its 2015 regular session. Based on this information and other WCPFC decisions, NMFS has identified the following as a reasonable range of options for this element of the proposed action, each of which would apply in the Convention Area between the latitudes of 20° N. and 20° S.:

1) A catch limit for each of the years 2015 through 2020 at the U.S. purse seine fishery's 2012 level of yellowfin tuna catch, which was 30,721 mt (the most recent recommendation of the Commission's Scientific Committee, upon which CMMs 2013-01 and 2014-01 were based, is that WCPO yellowfin tuna catches not be increased from 2012 levels).
2) A catch limit for each of the years 2015 through 2020 of 45,363 mt, the highest annual catch from 2001-2013 (2001 is the earliest baseline year referenced in the Commission's objectives for yellowfin tuna, as reflected in CMM 2008-01).
3) A catch limit for each of the years 2015 through 2020 of 8,448 mt, the lowest annual catch in the U.S. purse seine fishery from 2001-2013 (2001 is the earliest baseline year referenced in the Commission's objectives for yellowfin tuna, as reflected in CMM 2008-01).

2.1.9 Bigeye Tuna Catch Limits in the Purse Seine Fishery

The Commission has also discussed, though not yet adopted, the option of bigeye tuna catch limits in the purse seine fishery. The discussions have focused on the possibility of establishing catch limits instead of prohibitions on FAD-related fishing activities. NMFS has identified the following as a reasonable range of options for this element of the proposed action, each of which would apply in the Convention Area between the latitudes of 20° N. and 20° S.:

1) A catch limit for each of the years 2015 through 2020 of 7,763 mt, the highest annual bigeye tuna catch from 2001-2013 (2001 is the earliest baseline year referenced in the Commission's objectives for bigeye tuna, as reflected in CMM 2008-01).
2) A catch limit for each of the years 2015 through 2020 of 500 mt, which, based on data for 2003-2012, is the approximate average amount of bigeye tuna catch caught annually in unassociated sets.

2.2 *Alternative A: The No-Action Alternative*

Under Alternative A, the No-Action Alternative, NMFS would not implement WCPFC decisions on tropical tunas for 2015 through 2020. Thus, this alternative would result in conditions that are treated as the baseline for the purposes of assessing the impacts of the other alternatives. The inclusion of the No-Action Alternative serves the important function of facilitating comparison of the effects of the action alternatives and is a required part of a NEPA document. Under Alternative A, the U.S. longline and purse seine fleets operating in the WCPO would continue to be managed under existing laws and regulations, which are described in Chapter 3, Section 3.2 and Section 3.3 of this PEA.

2.3 *The Action Alternatives Analyzed in Depth in this PEA*

All the elements of the alternatives would be limited to the Convention Area and as further described below.

Table 1 below presents information on each of the alternatives described below.

Table 1: Table of Action Alternatives.

	Longline Bigeye Tuna Catch Limit	**Purse Seine Fishing Effort Limit**	**Purse Seine FAD Fishing/Setting Prohibition or Total Purse Seine Fishing Prohibition Period**	**Purse Seine FAD Set Limit**	**High Seas FAD Closure**	**Longline Yellowfin Tuna Catch Limit**	**Purse Seine Yellowfin Tuna Catch Limit**
Area of application[9]	Convention Area	Convention Area between latitudes of 20° N. and 20° S.	Convention Area between latitudes of 20° N. and 20° S.	Convention Area between latitudes of 20° N. and 20° S.	Convention Area between latitudes of 20° N. and 20° S.	Convention Area	Convention Area
Alternative B	3,554 mt in 2015 and 5,000 mt in each of the CYs[10] 2016-2020	3,898 fishing days in the ELAPS in each of the CYs 2015-2020	3-month FAD setting prohibition period in each of the CYs 2015-2020	Not included	Not included	1,142 mt in each of the CYs 2015-2020	45,363 mt in each of the CYs 2015-2020
Alternative C	2,090 mt in each of the CYs 2015-2020	432 fishing days on the high seas and 25 fishing days in the U.S. EEZ in each of the CYs 2015-2020	6-month total fishing prohibition period in each of the CYs 2015-2020	1,530 sets in each of the CYs 2015-2020	Yes, in 2017-2020	421 mt in each of the CYs 2015-2020	8,448 mt in each of the CYs 2015-2020

[9] The alternatives would not apply in the territorial seas or archipelagic waters of any nation, as defined by the domestic laws and regulations of that nation and recognized by the United States.
[10] " CY" stands for calendar year.

Alternative D	2,090 mt in each of the CYs 2015-2020	432 fishing days on the high seas and 25 fishing days in the U.S. EEZ in each of the CYs 2015-2020	Full year FAD setting prohibition period in each of the CYs 2015-2020	No FAD sets allowed	Yes, in 2017-2020	421 mt in each of the CYs 2015-2020	8,448 mt in each of the CYs 2015-2020
Alternative E	3,554 mt in 2015 and 5,000 mt in each of the CYs 2016-2020	3,898 fishing days in the ELAPS in each of the CYs 2015-2020	4-month FAD setting prohibition period in each of the CYs 2015-2020	Not included	Not included	1,142 mt in each of the CYs 2015-2020	45,363 mt in each of the CYs 2015-2020
Alternative F	3,554 mt in 2015 and 5,000 mt in each of the CYs 2016-2020	3,898 fishing days in the ELAPS in each of the CYs 2015-2020	3 month FAD setting prohibition period in each of the CYs 2015-2020	2,522 sets	Not included	1,142 mt in each of the CYs 2015-2020	45,363 mt in each of the CYs 2015-2020
Alternative G	3,554 mt in 2015 and 5,000 mt in each of the CYs 2016-2020	3,898 fishing days in the ELAPS in each of the CYs 2015-2020	3 month total fishing prohibition period in each of the CYs 2015-2020	Not included	Not included	1,142 mt in each of the CYs 2015-2020	45,363 mt in each of the CYs 2015-2020
Alternative H	2,090 mt in each of the CYs 2015-2020	432 fishing days on the high seas and 25 fishing days in the U.S. EEZ in each of the CYs 2015-2020	6 month total fishing prohibition period in each of the CYs 2015-2020	1,530 sets in each of the CYs 2015-2020	Not included	421 mt in each of the CYs 2015-2020	8,448 mt in each of the CYs 2015-2020

Alternative I	3,554 mt in 2015 and 5,000 mt in each of the CYs 2016-2020	1,828 fishing days in the ELAPS in each of the CYs 2015-2020	3 month FAD setting prohibition period in each of the CYs 2015-2020	Not included	Not included	1,142 mt in each of the CYs 2015-2020	45,363 mt in each of the CYs 2015-2020
Alternative J	3,554 mt in 2015 and 5,000 mt in each of the CYs 2016-2020	1,270 fishing days in the high seas and 558 fishing days in the U.S. EEZ in each of the CYs 2015-2020	3 month FAD setting prohibition period in each of the CYs 2015-2020	Not included	Not included	1,142 mt in each of the CYs 2015-2020	45,363 mt in each of the CYs 2015-2020
Alternative K	Multiyear variation of Alternative B: includes three-year catch and effort limits rather than single-year limits.						

2.3.1 **Alternative B, Least Restrictive Action Alternative**

Under this alternative, there would be a U.S. longline bigeye tuna catch limit of 3,554 mt in 2015 and 5,000 mt in each of the years from 2016-2020, and in each of the years 2015-2020, a U.S. purse seine fishing effort limit of 3,898 fishing days in the ELAPS, a three month FAD setting prohibition period for U.S. purse seine vessels, a yellowfin tuna catch limit of 1,142 mt for U.S. longline vessels, and a yellowfin tuna catch limit of 45,363 mt for U.S. purse seine vessels (the elements for purse seine vessels would apply between the latitudes of 20° N. and 20° S.).

2.3.2 **Alternative C, Most Restrictive Action Alternative**

Under this alternative, there would be a U.S. longline bigeye tuna catch limit of 2,090 mt in each of the years from 2015-2020, and in each of the years 2015-2020, a U.S. purse seine fishing effort limit of 432 fishing days on the high seas and 25 fishing days in the U.S. EEZ, a total prohibition on U.S. purse seine fishing for six months, in the remaining six months a limit of 1,530 FAD sets per year from 2015 through 2020 for U.S. purse seine vessels, a yellowfin tuna catch limit of 421 mt for U.S. longline vessels, a yellowfin tuna catch limit of 8,448 mt for U.S. purse seine vessels, and a complete prohibition on fishing on FADs on the high seas for U.S. purse seine vessels in 2017 through 2020 (the elements for purse seine vessels would apply between the latitudes of 20° N. and 20° S.).

2.3.3 **Alternative D, Most Restrictive FAD Setting Prohibition Period Variation**

This alternative would be the same as Alternative C, except that instead of a total prohibition on U.S. purse seine fishing for six months, there would be a FAD setting prohibition period for the full year each year.

2.3.4 **Alternative E, Additional FAD Setting Prohibition Period**

This alternative would be the same as Alternative B, except that instead of a three month FAD setting prohibition period, there would be a four-month FAD setting prohibition period each year.

2.3.5 **Alternative F, FAD Set Limit Variation**

This alternative would be the same as Alternative B, except that there would also be a limit of 2,522 FAD sets per year.

2.3.6 **Alternative G, Total Purse Seine Closure Variation**

This alternative would be the same as Alternative B, except that instead of a three month FAD setting prohibition period, there would be a total prohibition on U.S. purse seine fishing for three months each year.

2.3.7 **Alternative H, Most Restrictive Without High Seas FAD Closure**

This alternative would be the same as Alternative C, except that there would be no prohibition on fishing on FADs on the high seas for U.S. purse seine vessels in 2017 through 2020.

2.3.8 **Alternative I, Variation on Purse Seine Fishing Effort Limits**

This alternative would be the same as Alternative B, except that the U.S. purse seine fishing effort limit would be 1,828 fishing days per year in the ELAPS.

2.3.9 **Alternative J, Variation on Purse Seine Fishing Effort Limits, Separate Areas**

This alternative would the same as Alternative B, except that the U.S. purse seine fishing effort limit would be 1,270 fishing days per year on the high seas and 558 fishing days per year in the U.S. EEZ.

2.3.10 **Alternative K, Multiyear Limits**

This alternative would be the same as Alternative B, except that the longline bigeye tuna catch limits, the purse seine fishing effort limit, the longline yellowfin tuna catch limit, and the purse seine yellowfin tuna catch limit would be applied on a multiyear basis. In other words, rather than being calendar year annual limits, all of these limits would be applied to three-year periods. NMFS has implemented WCPFC decisions on tropical tunas as three-year limits in the past and may do so in the future.

2.4 ***Alternatives Excluded from Detailed Analyses***

As described in Section 2.1 of this PEA, NMFS identified multiple options for many of the elements of the proposed action. The alternatives described in Section 2.3 do not include all possible combinations of the identified options. However, NMFS believes that the action alternatives described in Section 2.3 constitute a reasonable range of combinations of the various options that meet the purpose of and need for the proposed action.

Chapter 3 Affected Environment

This chapter describes the physical and biological environment affected by the U.S. purse seine and longline fisheries in the WCPO, focusing on the resources that could be affected by implementation of the proposed action under any of the action alternatives. The chapter is divided as follows: (1) physical environment; (2) description of the U.S. WCPO purse seine fleet; (3) description of the Hawaii and west coast longline fleets that would be affected by the implementation of the bigeye catch limit; (4) brief description of all Convention Area fisheries; (5) bigeye and yellowfin tuna and the principal target stocks associated with the purse seine and longline fisheries; (6) other biological resources; and (7) protected resources.

3.1 *Physical Environment of the WCPO*

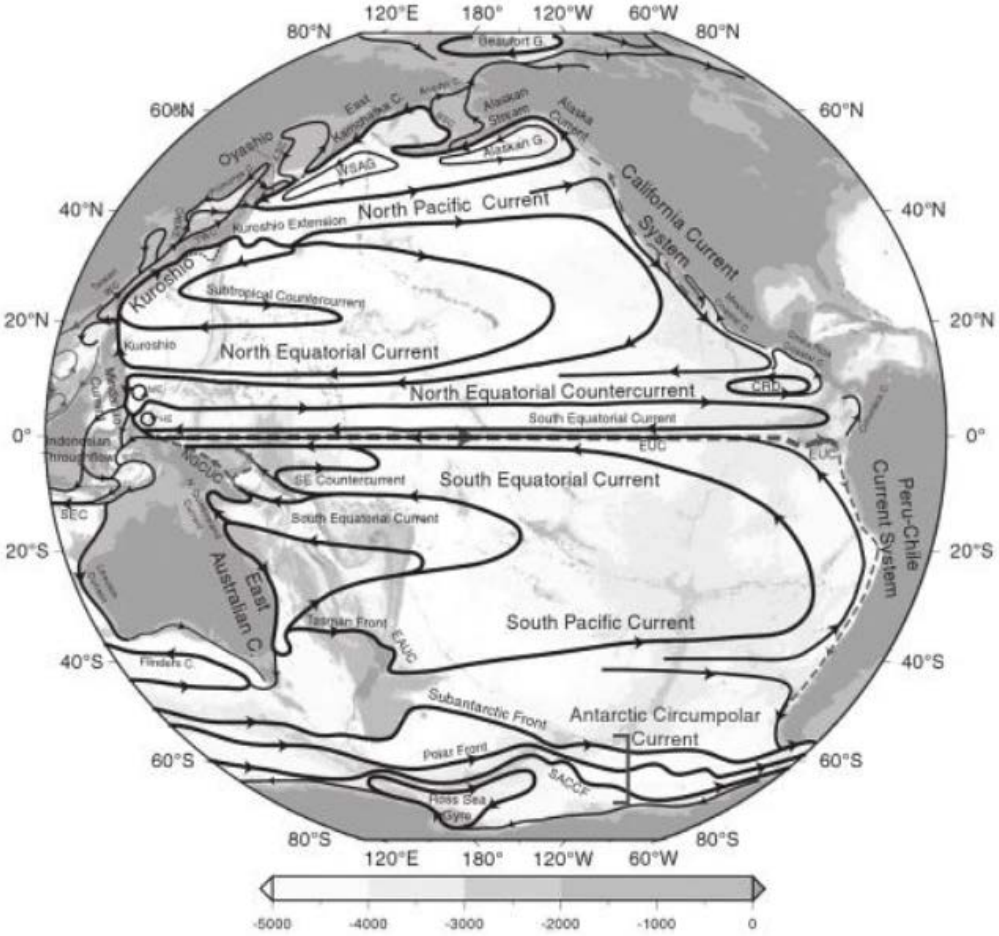
The physical reach of the Convention Area (as shown in Chapter 1), comprises all waters of the Pacific Ocean bounded to the south and to the east by the following line: from the south coast of Australia due south along the 141° meridian of east longitude to its intersection with the 55° parallel of south latitude; thence due east along the 55° parallel of south latitude to its intersection with the 150° meridian of east longitude; thence due south along the 150° meridian of east longitude to its intersection with the 60° parallel of south latitude; thence due east along the 60° parallel of south latitude to its intersection with the 130° meridian of west longitude; thence due north along the 130° meridian of west longitude to its intersection with the 4° parallel of south latitude; thence due west along the 4° parallel of south latitude to its intersection with the 150° meridian of west longitude; thence due north along the 150° meridian of west longitude.

Below is a description of the specific physical environment in which the WCPO purse seine and longline fisheries operate and how physical features of the pelagic environment, as well as the distribution of HMS, influence these fisheries.

3.1.1 Oceanography

The WCPO contains several major currents and gyres that control most of the mixing patterns and nutrient flow of the system. In the Pacific there are two subtropical gyres, one in the northern hemisphere and one in the southern hemisphere. There are also several other major currents that drive circulation in the Pacific Ocean (Figure 2).

Figure 2: Main currents of the Pacific Ocean



Source: Talley et al. 2011.

Subtropical gyres rotate clockwise in the northern hemisphere and counter clockwise in the southern hemisphere in response to trade and westerly wind forces. Due to this, the central Pacific Ocean (~20° N latitude- 20° S latitude) experiences weak mean currents flowing from east to west, while the northern and southern portions of the Pacific Ocean experience a weak mean current flowing from west to east. Embedded in the mean flow are numerous mesoscale eddies which are turbulent or spinning flows on scales of a few hundred kilometers created from interactions between wind, currents, and the ocean's bathymetry (Stewart 2008). These eddies, which can rotate either clockwise or counter clockwise, typically have important biological impacts. The edges of eddies, where the mixing is greatest, are often targeted by fishermen as these are areas of high biological productivity.

Global wind patterns, Ekman transport (the net transport of water driven by wind stress and the Coriolis force), and eddy currents create vertical fluxes, with regions of divergence causing upwelling, a process where the thermocline becomes shallower and deep nutrient-rich waters are pumped into surface waters enhancing phytoplankton production. The opposite occurs in regions of convergence (downwelling) where the thermocline deepens (Talley et al. 2011). The edges of eddies, where the mixing is greatest, are often targeted by fishermen as these are areas of high biological productivity.

The subtropical frontal zones, consisting of several convergent fronts, lie between latitudes 25°-40° N. and S., and are often referred to as the Transition Zones. Transition zones are areas of ocean water bounded to the north and south by large-scale surface currents originating from subarctic and subtropical locations (Polovina et al. 2001). These zones also provide important habitat for pelagic fish and thus, are targeted by fishers.

Currents and mixing patterns are influenced by large-scale oceanographic events, such as El Niño Southern Oscillation (ENSO) [11], or La Niña, which change the characteristics of water temperature and productivity. ENSO events cause interannual physical and biological variation. During an El Niño, the normal easterly trade winds weaken, resulting in a weakening of the westward equatorial surface current and a deepening of the thermocline in the central and eastern equatorial Pacific. In turn, the eastward-flowing countercurrent tends to dominate circulation, bringing warm, low-salinity, and low-nutrient water to the eastern margins of the Pacific Ocean. As the easterly trade winds are reduced, the normal nutrient-rich upwelling system slows, leaving warm, nutrient poor surface water pooled in the Eastern Pacific Ocean (EPO) (Kamikuri et al. 2009).

Variability within the ocean–atmosphere system also results in changes in winds, rainfall, currents, water column mixing, and sea-level heights, which can have profound effects on regional climates as well as on the abundance and distribution of marine organisms. In the tropical Pacific there is a limited seasonal variation, yet there is a strong interannual variability which in turn affects the entire Pacific Ocean (Langley et al. 2004).

The scientific community has become increasingly aware of the occurrence and importance of long-term (decadal-scale) oceanographic cycles and of their relationship to cycles in the population sizes of some species of fish (Chavez et al. 2003). These naturally occurring cycles can either mitigate or accentuate the impact of fishing mortality on all species, especially those targeted in HMS fisheries. ENSO events and shorter term phenomena such as cyclonic eddies near the Hawaiian Islands, impact the recruitment and fishing vulnerability of highly migratory species (Seki et al. 2002).

The deepening of the mixed layer depth that occurs with most El Niño events may be accompanied by a discernable increase in purse seine catch per unit of effort (CPUE) of yellowfin tuna in the eastern WCPO. This is normally seen after a 2-3 month delay and occurs in the vicinity of Kiribati and the U.S. EEZs of the central Pacific (around Howland, Baker, Jarvis etc.). During a strong El Niño, the purse seine fishery for skipjack tuna shifts over 1,000

[11] ENSO events include the full range of variation observed between El Niño and La Niña events. El Niño is characterized by a large-scale weakening of the trade winds and warming of the surface layers in the eastern and central equatorial Pacific. El Niño events occur irregularly at intervals of 2–7 years, although the average is about once every 3–4 years. These events typically last 12–18 months, and are accompanied by swings in the Southern Oscillation, an interannual “see-saw” in tropical sea level pressure between the eastern and western hemispheres. During El Niño, unusually high atmospheric sea level pressures develop in the western tropical Pacific and Indian Ocean regions, and unusually low sea level pressures develop in the southeastern tropical Pacific. Southern Oscillation tendencies for unusually low pressures west of the dateline and high pressures east of the dateline have also been linked to periods of anomalously cold equatorial Pacific sea surface temperatures sometimes referred to as La Niña (NMFS 2004).

kilometers from the western to the central equatorial Pacific in response to physical and biological impacts (Lehodey et al. 1997). The major change is a horizontal extension or contraction of the skipjack tuna habitat during El Niño and La Niña phases respectively. Strong El Niño events also may show a positive effect on bigeye tuna CPUE in these regions for the longline fleets. During a La Niña event, cooler than normal sea-surface temperatures in the central and eastern tropical Pacific Ocean may cause the contraction of the warm pool which shifts purse seine fishing to the western portion of the WCPO in the vicinity of Papua New Guinea and the Federated States of Micronesia, or away from the U.S. EEZ in the central Pacific and those areas to the north of American Samoa (e.g., near Kiribati).

Physical and biological oceanographic changes have also been observed on decadal time scales. These low frequency changes, termed regime shifts, can impact the entire ocean basin. Recent regime shifts in the North Pacific have occurred in 1976 and 1989, with both physical and biological (including fishery) impacts (Polovina et al. 1995; Polovina 1996). These impacts can lead to potential impacts on the tropical Pacific fisheries for tunas such as the extension of present fisheries to higher latitudes, a decrease in productivity (mainly in the EPO), an increase in catch variability, changes in species composition, and increasing fishing pressure, particularly on bigeye and yellowfin tuna (The World Bank 2000).

Variability within the ocean–atmosphere system results in changes in winds, rainfall, currents, water column mixing, and sea-level heights, which can have profound effects on regional climates as well as on the abundance and distribution of marine organisms. In the tropical Pacific there is a limited seasonal variation, yet there is a strong interannual variability which in turn affects the entire Pacific Ocean (Langley et al. 2004). These events affect the habitat range and movements of pelagic species. Geographic distribution of all species, especially HMS, varies with seasonal changes in the physical and chemical ocean environment. Suitable physical environment for these species depends on gradients in temperature, oxygen, or salinity, all of which are influenced by oceanic conditions on various scales. In the pelagic environment, physical conditions such as isotherm and isohaline boundaries often determine whether or not the surrounding water mass is suitable for pelagic fish. Additionally, areas of high trophic transfer as found in fronts and eddies are important habitat for foraging, migration, and reproduction for many species (Bakun 1996).

The bulk of marine life is found near divergences and convergences that concentrate forage species, and also near upwelling zones along ocean current boundaries, and temperature, oxygen, salinity, light, and depth gradients (Niller and Reynolds 1984; Roden 1980; Seki et al. 2002). Biologically, these convergent fronts appear to represent zones of enhanced trophic transfer (Bakun 1996; Olson et al. 1994). The dense cooler phytoplankton-rich water sinks below the warmer water creating a convergence of phytoplankton (Polovina et al. 2000; Roden 1980). Buoyant organisms, such as jellyfish as well as vertically swimming zooplankton, can maintain their vertical position in the weak down-welling, and aggregate in the front to graze on the down-welled phytoplankton (Bakun 1996; Olson et al. 1994). The increased level of biological productivity in these zones attracts higher trophic level prey and their predators.

3.1.2 Climate Change

Climate change can affect the marine environment by impacting the established hydrologic cycle (e.g., a change in precipitation and evaporation rates) (Bala et al. 2010). This in turn may cause a shift in food web dynamics, such as a reduction in primary productivity, which affects HMS migration and distribution (Dambacher et al. 2010, Loukos et al. 2003). Climate change has been associated with other effects to the marine environment, including rising oceanic temperatures, pH, changes in ice cover, salinity, oxygen levels, and circulation (Intergovernmental Panel on Climate Change 2007). These effects are leading to shifts in the range, abundance, and behaviors of algae, plankton, fish and other sea life (Solomon et al. 2007). Coral reefs are also being damaged through ocean acidification and sea level rise (Carpenter et al. 2008, Mayfield et al. 2012, and Munday et al. 2012). There are many predictions pertaining to the rate of change and potential maximums of sea level rise but studies indicate the change is caused by rising global temperatures and ice melt (Rahmstorf 2007). Sea level changes could potentially damage the nesting, breeding, foraging, and migratory sites of coastal marine sea birds (Galbraith et al. 2002) and other vertebrate megafauna such as pinnipeds and turtles (Baker et al. 2006).

Climate change is also increasing the incidence of disease in aquatic organisms (Roessig et al. 2004, Hoegh-Guldberg and Bruno 2010, van Woesik et al. 2012), as well as the spread of invasive species (Hoegh-Guldberg and Bruno 2010). Studies on planktonic ecosystems demonstrate that climate change is affecting phytoplankton abundance and distribution, which in turn affects consumers ranging from zooplankton to megafauna (Hays et al. 2005). Changes in plankton affect ecosystem services such as oxygen production, carbon sequestration, and biogeochemical cycling (Edwards et al. 2010). All of these studies concluded that fish, seabirds, and marine mammals will need to adapt to shifts in spatial distribution of primary and secondary production within pelagic marine ecosystems (Hoegh-Guldberg and Bruno 2010, Dambacher et al. 2010).

Studies conducted by Perry et al. (2005) indicate that climate change may be impacting marine fish distributions, which in turn may have important ecological impacts on ecosystems and commercial fisheries. Climate change may impact commercial fisheries by: (1) increasing in ocean stratification leading to less primary production, which in turn leads to less overall energy for fish production; (2) decreasing spawning habitat leading to decreased stock sizes; and (3) changes in currents that may lead to changes in larval dispersal and retention, which could also lead to decreases in stock sizes (Roessig et al. 2004).

Ainsworth et al. (2011) also investigated potential climate change impacts on commercially valuable species of fish, stimulating changes in (1) primary productivity; (2) species range shifts; (3) zooplankton community size structure; (4) ocean acidification; and (5) ocean deoxygenation. Climate change may also impact marine carrying capacity and relative suitable habitats for fish stocks, theoretically either positively or negatively affecting the levels of growth and survival of certain fish populations (Kaeriyama et al. 2012).

Ocean habitat may be affected by changes in pH associated with climate change. The global average pH has risen 0.1 units (Farby et al. 2008) since the beginning of the Industrial Revolution, due to increased levels of carbon dioxide (CO_2) both anthropogenically and naturally

released. Any creature that produces a carbonate shell is vulnerable to the carbonic acid (it dissolves carbonate) that is produced by the reaction between atmospheric CO_2 and seawater. Most of these creatures are small phytoplankton and zooplankton, but larger crustaceans and mollusks are vulnerable to dissolution as well, especially in juvenile stages (Farby et al. 2008). Coral reefs are also damaged by increasing ocean acidity levels (Hoegh-Guldberg et al. 2007). As these organisms form, feed, or support many levels of the food chain, as well as provide many other important ecosystem services, any major loss of diversity or productivity could impact higher trophic levels and the environment as a whole.

3.1.3 Habitat Change

Areas near coastlines are especially sensitive to nutrient influxes. Rivers discharge elements like phosphorous and nitrogen from both natural sources like green waste or from human activity such as fertilizer runoff, sewage discharge, urban storm water, and deposition of atmospheric particles from fossil fuel combustion (Paerl 1997, Slomp and Cappellen 2004). Iron, another typically limiting nutrient, is blown into the ocean through dust clouds. An overdose from any of these sources can cause eutrophication of coastal waters, including blooms of algae that can produce a toxin that can be consumed by shellfish and transmitted to their consumers, including humans (Paerl 1997). Eutrophication can also block sunlight and starve photosynthetic benthic life. Nutrients are also often transported in particulate form which can accumulate and smother benthic communities.

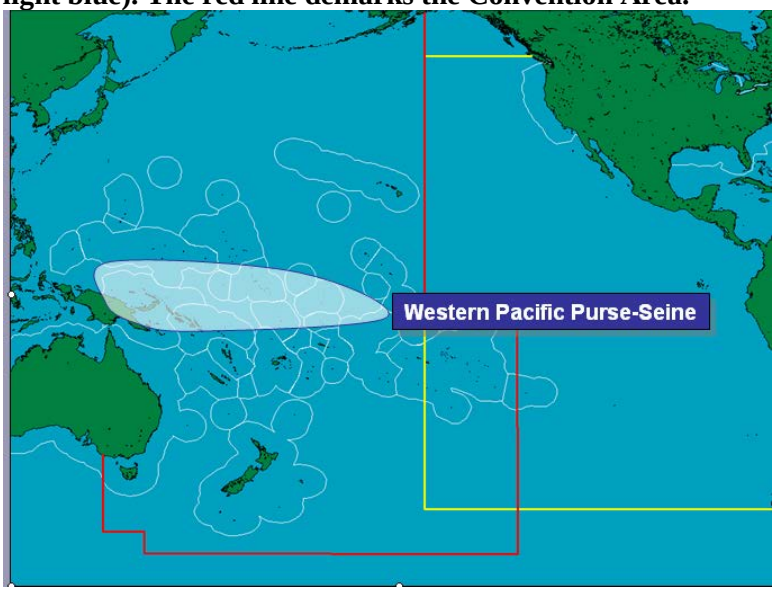
Other impacts to ocean habitat come from pollution, and construction. The following are examples of pollution: CO_2, nitrogen and phosphorus, radioactive waste, plastic and other trash, chemicals and pharmaceuticals, mercury from coal fired power plants, oil spills, and even noise and heat. The construction of shoreline or at sea structures can also impact habitat by altering substrate, removing areas from biological use, creating noise and vibration pollution, as well as disturbing/disrupting sediment dynamics. Animals can be blocked from traditional habitat or breeding grounds, scared away, disoriented or poisoned.

Over exploitation of any species can disrupt ecosystem balance. Over exploitation can come from fishing pressure or natural pressures from higher trophic levels. A reduction in a prey species can cause higher trophic levels to collapse; conversely, by removing top predators, mid and low trophic level species may expand due to the elimination of competition and predation, which may in turn cause overgrazing on the lowest trophic levels (Hinke et al. 2004, Halpern et al. 2006).

3.2 *U.S. WCPO Purse Seine Fishery*

Vessels of the U.S. purse seine fishery engage in targeting skipjack and to a lesser extent yellowfin tuna throughout the equatorial regions of the Convention Area. The U.S. WCPO purse seine fleet operates mostly in the EEZs of Pacific Island Countries (PIC) between 10° N and 10° S within the Convention Area (Figure 3).

Figure 3: The general operational area of the U.S. WCPO purse seine fishery (indicative only, in light blue). The red line demarks the Convention Area.



Source: NMFS unpublished data

3.2.1 **Fleet Characteristics**

Gillett et al. (2002) provide a detailed description of the historical development and expansion of the U.S. WCPO purse seine fleet from its bases in the EPO. Beginning in the late 1970s, the U.S. fleet developed a year-round fishery along the Equator, generally within a rectangular area bounded by 10° N-10° S latitude and 135° E-170° E longitude, and encompassing the EEZs of Palau, Federated States of Micronesia, Papua New Guinea, Solomon Islands, Nauru, Marshall Islands, and the Gilbert Islands group of Kiribati. Fishing grounds continued to expand eastward throughout the 1980s, eventually encompassing the Phoenix and Line Islands (Kiribati); the U.S. possessions of Howland, Baker, and Jarvis; Tokelau; and the high seas between these EEZ areas. U.S. purse seiners typically target skipjack and yellowfin tuna found in association with drifting logs/flotsam or FADs and also unassociated free-swimming schools of tuna ("school sets"). The relative proportion of the different set types has varied considerably over time as oceanographic conditions and technology have changed.

Large modern purse seiners are one of the most complex fishing vessels in terms of both technology and machinery. Hydraulic systems on large "super seiners," require more than 1,600 meters of piping, and are equipped with at least four auxiliary engines in addition to the main propulsion engine (or engines). The purse seine technique for catching tuna involves employing a net that is set vertically in the water, with floats attached to the upper edge and chains for weight on the lower edge. A series of rings is attached to the lower edge of the net, and a pursing cable passes through the rings, enabling a winch on board the vessel to draw the net closed on the bottom. Purse seine nets can be up to 1,500 meters or more in length and 150 meters in depth. When the net is deployed from the purse seine vessel, a large skiff carrying the end of the net is released from the stern of the fishing vessel. The purse seine vessel encloses the school of tuna, keeping it in visual contact if on the surface, or using sonar if below the surface, and then retrieves most of the pursed net onto the vessel. The fish are confined in the "sack" portion of the

net, which consists of finer mesh webbing that prohibits their escape. The catch is removed from the sack onto the vessel with large "scoops," known as brails, holding several metric tons (mt), and is then placed in one of many brine tanks for freezing and later storage. Joseph (2003) and NMFS (2004) provide a detailed description of tuna purse seining and the fleets involved in the Pacific Ocean fisheries. Although these studies are ten or more years old, basic vessel design is approximately the same while certain gear elements have significantly improved.

3.2.2 **Management of the U.S. Purse Seine Fleet in the WCPO**

The fishing activities of U.S. WCPO purse seine vessels are governed in large part by the Treaty on Fisheries between the Governments of certain Pacific Islands States and the Government of the United States of America (SPTT or Treaty). The SPTT manages access of U.S. purse seine vessels to the EEZs of Pacific Islands Parties to the SPTT and provides for technical assistance in the area of Pacific Island Country fisheries development. The SPTT is implemented domestically by regulations (50 CFR 300 Subpart D) issued under authority of the South Pacific Tuna Act of 1988 (SPTA; 16 U.S.C. 973-973r). As of this writing, certain agreements that operationalize the SPTT are being renegotiated, which may result in changes to the current management regime. The High Seas Fishing Compliance Act and implementing regulations (50 CFR 300 Subpart B), the WCPFCIA and implementing regulations (50 CFR 300 Subpart O), and regulations implementing the Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region (Pelagics FEP) pursuant to the MSA (50 CFR Part 665) also regulate this fishery. The main fishery management regulations are:

- All U.S. vessels that fish (as defined under 50 CFR § 300.2) on the high seas are required to have a permit in accordance with the High Seas Fishing Compliance Act (HSFCA) and, if fishing on the high seas in the Convention Area, a WCPFC Area Endorsement;

- A U.S. purse seine vessels operating in the WCPO must have a license issued by the Pacific Islands Forum Fisheries Agency (FFA) as Treaty Administrator on behalf of the Pacific Island Parties to the SPTT. The SPTT and implementing regulations provide for the availability of 45 licenses, five of which are only available to fishing vessels engaged in joint venture arrangements with the Pacific Islands Parties. No joint venture licenses have ever been issued.

- Within the SPTT Area there are several types of designated geographical areas, as described below:

    1. The **Treaty Area** which is about 10 million square miles in size.

    2. The **Licensing Area** where a license is required in order to fish. The Licensing Area means all waters in the Treaty Area except for those waters subject to the jurisdiction of the United States, those waters within closed areas, and those waters within limited areas closed to fishing.

3. **Closed Areas** are those specific areas within the Treaty Area in which U.S. purse seine vessels are not allowed to fish.

- U.S. purse seine vessels are prohibited from transshipping fish at sea in the Convention Area and from transshipping fish caught in the Convention Area anywhere else;

- A U.S. purse seine vessel cannot be used for directed fishing for southern bluefin tuna or for fishing for any kinds of fish other than tunas, except fish that may be caught incidentally;

- Holders of vessel licenses are required to submit both written and electronic reports on their fishing activities in the Treaty Area to NMFS, the FFA or the local marine resource authority in which the vessel is operating;

- U.S. purse seine vessels are required to carry and operate mobile transmitting units to provide automated position information as part of a vessel monitoring system (VMS) administered by NMFS and by the FFA;

- U.S. purse seine vessels are required to be identified in accordance with the 1989 United Nations Food and Agriculture Organization standard specifications for the marking and identification of fishing vessels, which requires that the vessel's international radio call sign be marked on the hull and deck

- U.S. purse seine vessels operating in the Convention Area must submit specific reports on transhipments, discards, and entries into and exits from a certain area of the high seas (i.e., Eastern High Seas Special Management Area; 50 CFR 300.225);

- U.S. purse seine vessels fishing in the Convention Area must follow certain sea turtle interaction mitigation measures;

- U.S. purse seine vessels must retain all catch of bigeye, yellowfin, and skipjack tuna, subject to certain exceptions;

- U.S. purse seine vessels must not set or attempt to set on around a whale shark (*Rhincodon typus*) and must release any whale shark that is encircled;

- U.S. purse seine vessels cannot retain on board, tranship, store, or land any part or whole carcass of an oceanic whitetip shark (*Carcharhinus longimanus)* or silky shark (*Carcharhinus falciformis*) and must release any oceanic whitetip shark or silky shark as soon as possible;

- U.S. purse seine vessels equal to or greater than 50 feet (15.2 meters) in length overall generally cannot fish in a certain portion of the U.S. EEZ around American Samoa; and

- For the last 27 years, pursuant to the terms of the SPTT, U.S. purse seine vessels must carry observers on at least twenty percent of their trips (see SPTT, Annex I, Part 7). However, beginning in 2010, purse seine vessels have been required to carry WCPFC observers on all trips, with certain exceptions. Observers for the fleet are deployed by the FFA.

Beyond the closed areas cited above, in 2006 Kiribati formed the Phoenix Islands Protected Area (PIPA) in a portion of its EEZ, which is about 140,000 square miles in size. On January 1, 2015, Kiribati banned all commercial fishing within the PIPA. This prohibition applies to the U.S. WCPO purse seine fleet.

Observers can provide useful information that is independent of vessel operators and is obtained during actual fishing operations. Data typically collected by observers include catch composition by species, effort, location, environmental conditions, gear type, and information on bycatch. FFA-deployed observers on U.S. WCPO purse seine vessels collect detailed information on bycatch and discards in the WCPO purse seine fishery and these data are routinely used to provide estimates of total bycatch and discards and the extent of interaction with species of special interest (e.g., marine mammals and turtles) (Secretariat of the Pacific Community (SPC) 2013b).

3.2.3 **Participation, Effort, and Catch**

Participation in the U.S. WCPO purse seine fishery increased from the late 1980s to the mid-1990s, peaking at approximately 50 vessels, and gradually decreased until a low was reached in 2006. The fleet has since increased to about the levels of the mid 1990s, and has been relatively stable for the past five years. As of April 2015, the U.S. WCPO purse seine fleet consisted of 37 licensed vessels.

The U.S. WCPO purse seine fleet spent, from 1997 through 2013, about 5% of its effort in the U.S. EEZ, 18% on the high seas, and the remainder in the EEZs of PIC (unpublished NMFS data). The percentages for any given year during that period ranged from about <0.5% to 21% for the U.S. EEZ, about 5% to 30% for the high seas, and about 60% to 95% for the EEZs of PIC. Table 2 shows the effort data for the high seas, U.S. EEZ, and PIC EEZ regions for 1997-2013 (unpublished NMFS data). Data for 2012 and 2013 are preliminary.

Effective June 15, 2013, while certain SPTT instruments are being renegotiated, the U.S. purse seine fleet's fishing effort in foreign EEZs in the WCPO was constrained not only by limits on the number of allowable vessels, as in the past, but also by limits on the number of allowable fishing days. These limits have been established in interim arrangements between the parties.

During the 18.5 months from June 15, 2013, through December 31, 2014, the U.S. purse seine fleet was authorized 12,000 fishing days in the EEZs of the Parties to the Nauru Agreement (PNA) and 450 fishing days in the EEZs of the other FFA members. For 2015, the fleet has access to a total of 8,301 fishing days in the waters of the FFA members, but there are additional

constraints on where some of the fishing days can be used.[12] As of this writing, no access agreements under the SPTT have been reached for any period after calendar 2015, but it is very likely that new arrangements will be agreed for years subsequent to 2015 and that there may be additional constraining limits on U.S. purse seine fishing effort in its primary fishing grounds. The nature of those agreements and limits cannot be predicted as of this writing.

Table 2: U.S. WCPO purse seine fleet fishing effort (1997-2013) in the Convention Area. [13]

Year	U.S. EEZ Effort	U.S. % days	High seas Effort	High Seas % days	PIC Effort	PIC % days	Total Effort	Number of Active Vessels[14]	Number of Sets
1997	1,469	21%	1,311	19%	4,177	60%	6,957	35	5,675
1998	460	8%	1,556	25%	4,099	67%	6,115	39	4,857
1999	234	5%	1,156	24%	3,368	71%	4,758	36	3,415
2000	128	3%	883	19%	3,529	78%	4,539	33	3,666
2001	336	7%	929	19%	3,711	75%	4,977	31	4,058
2002	440	8%	1,306	24%	3,803	69%	5,549	29	4,768
2003	215	5%	900	19%	3,643	77%	4,758	26	3,166
2004	288	7%	1,030	25%	2,795	68%	4,113	21	2,657
2005	137	4%	832	26%	2,177	69%	3,146	15	2,386
2006	184	7%	543	20%	1,932	73%	2,659	13	1,966
2007	92	3%	787	29%	1,869	68%	2,747	20	2,008
2008	60	1%	1,506	22%	5,415	78%	6,981	36	6,558
2009	101	1%	1,704	21%	6,500	78%	8,306	39	8,278
2010	23	0%	400	5%	7,687	95%	8,110	37	8,640
2011	38	0%	573	8%	7,217	91%	7,828	36	6,295
2012	198	2%	1,219	14%	7,056	83%	8,473	39	8,704
2013	167	2%	999	13%	6,541	85%	7,707	40	7,699
Total	**4,570**	**5%**	**17,634**	**18%**	**75,519**	**77%**	**97,723**	**-**	**84,796**
AVG.	**269**	**5%**	**1,037**	**18%**	**4,442**	**77%**	**5,748**	**31**	**4,988**

Source: NMFS unpublished data.

Based on preliminary estimates, the U.S. WCPO purse seine fleet landed approximately 291,948 metric tons of tuna in 2014 (USCG and NOAA 2015). As shown in Table 3 below, skipjack tuna generally account for the majority of the catch, followed by yellowfin tuna, with bigeye tuna accounting for only a small proportion.

Table 3 shows the retained catch in the Convention Area by U.S. purse seine vessels.

[12] The fleet is allowed 7,701 fishing days in the waters of the PNA other than Kiribati, 300 fishing days in the waters of Kiribati, and 300 fishing days in the waters of the non-PNA members of the FFA other than Palau.
[13] A fishing day is defined as any day in which a fishing vessel of the United States equipped with purse seine gear searches for fish, deploys a FAD, services a FAD, or sets a purse seine, with the exception of setting a purse seine solely for the purpose of testing or cleaning the gear and resulting in no catch.
[14] Number of vessels indicates the total number of unique vessels contributing to the data for a given year.

Table 3: Retained catch of the U.S. purse seine fishery in the Convention Area, 1997-2013.

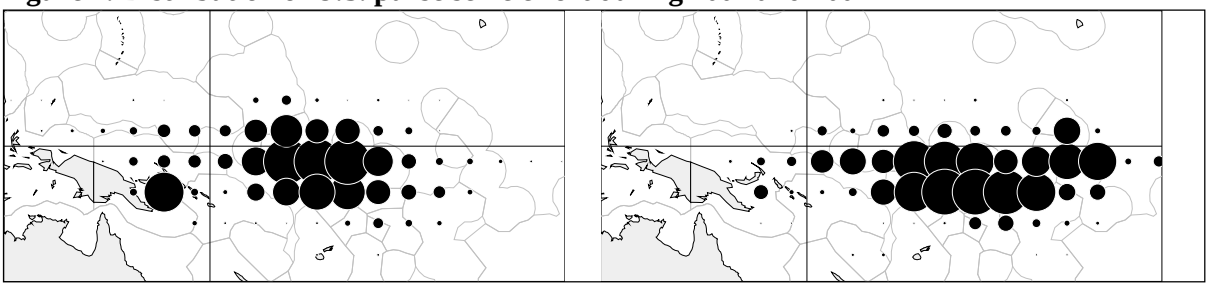
Year	Skipjack tuna retained catches (mt)	Yellowfin tuna retained catches (mt)	Bigeye tuna retained catches (mt)
1997	79,386	54,638	10,058
1998	131,573	37,530	5,525
1999	129,262	35,820	17,403
2000	81,368	29,961	12,953
2001	85,539	24,143	6,176
2002	88,535	27,191	4,889
2003	62,907	20,079	4,470
2004	47,896	14,492	5,031
2005	62,379	17,685	6,108
2006	55,633	8,448	4,364
2007	75,210	10,541	2,985
2008	159,741	45,363	4,220
2009	253,783	21,245	6,561
2010	207,074	32,494	4,878
2011	169,154	24,442	7,838
2012	215,702	31,679	5,503
2013	226,609	23,277	8,157

Source: U.S. Annual Report Part 1 to WCPFC for catches for 2001-2014 (available at www.wcpfc.int); U.S. data submission to WCPFC in 2015. Coan, Sakagawa and Yamasaki 2002 for 1997-2000.

Purse seine fishing effort in the WCPO is typically not characterized by any marked or documented seasonal patterns. The spatial distribution of fishing effort is, however, strongly influenced by the (irregular) cycles associated with ENSO events, revealing strong temporal variation on the scale of years and decades. The distribution of catch by the WCPO purse seine fishery is strongly influenced by ENSO events, traditionally shifting east of 160° E during El Niño events and west of 160° E during La Niña periods. El Niño–related eastward shifts of nearly 4,000 kilometers have been noted during periods of only six months.

Figure 4 indicates U.S. purse seine effort during a transitional year between an El Niño and La Niña period (2001) and an El Niño period (2002). Effort in strong La Niña conditions normally shifts west of the vertical line indicating 160° E longitude.

Figure 4: Distribution of U.S. purse seine effort during 2001 and 2002



Source: Williams 2003. (The largest circle size indicates ≥ 360 days fishing or searching.)

3.2.4 **FADs**

Fish aggregating devices, or FADs, are man-made devices or natural floating objects, anchored or not, capable of aggregating fish. FAD sets tend to catch higher proportions of skipjack and juvenile bigeye tuna respective to the total catch of each species (Hampton et al. 2006). Fishing on drifting FADs, beyond being typically a more successful way of catching tuna, has also shown decreases in average size of target catch, increases in catches of bigeye, and increases in bycatch when compared to unassociated sets (Gillet et al. 2002). FAD sets also show a more varied composition of catch.

As shown in Table 4, the WCPO purse seine fleet catches mostly skipjack and yellowfin tuna. Based on data compiled by SPC (SPC 2013a), FAD sets generally yield higher catch rates (mt/day) for skipjack tuna than unassociated sets. Data from SPC also indicates that unassociated sets generally yield a higher catch rate for yellowfin tuna than FAD sets. This may be explained from the occurrence of unassociated sets in the more eastern areas of the Convention Area containing "pure" schools of large, adult yellowfin, which account for a larger catch (by weight) than the (mostly) juvenile yellowfin encountered in FAD sets (SPC 2012a). Table 4 shows the breakdown of catch by set type for the U.S. purse seine fleet between the years 2003-2012.

Table 4: Annual U.S. WCPO purse seine catch estimates in metric tons by set type (unassociated and associated), 2003-2012 (data for 2012 are preliminary)

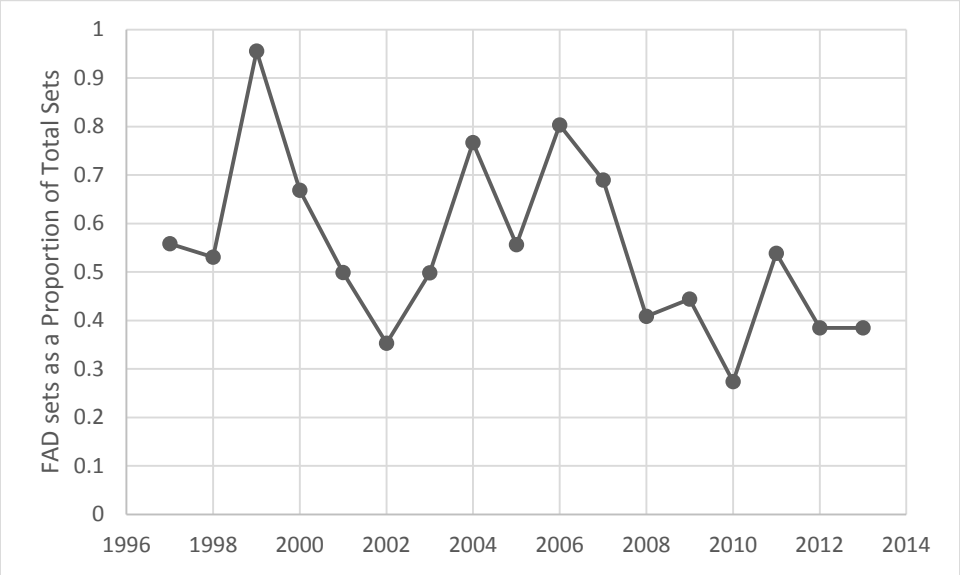
Year	Skipjack		Yellowfin		Bigeye		Totals
	Unass.	Ass.	Unass.	Ass.	Unass.	Ass.	
2003	24,848	39,248	12,773	8,331	143	2,166	87,509
2004	8,660	44,843	1,943	10,404	89	3,538	69,477
2005	24,619	36,968	8,483	11,650	481	3,969	86,170
2006	4,825	52,949	1,927	6,213	118	2,413	68,445
2007	14,306	55,842	2,466	12,587	100	3,435	88,736
2008	69,170	89,935	20,058	23,491	466	6,203	209,323
2009	96,975	138,645	9,005	26,975	777	9,212	281,589
2010	112,738	86,504	18,993	19,878	1,111	6,302	245,526
2011	54,424	113,328	4,093	21,328	328	9,714	203,215
2012	81,724	108,302	23,458	5,675	103	1,594	220,856
Total	120,682	302,176	43,430	49,448	950	16,049	532,735

Source: SPC 2009. SPC 2013a

As indicated in Figure 5, over the last fifteen years, FADs, or what are more broadly referred to as associated sets, which includes sets on natural or floating objects, have been responsible for

more than 90% of all sets made by the fleet in some years, and less than 30% in other years. There are many factors that cause this variability, not all of which are fully understood (i.e., other than perhaps by the purse seine vessel operators themselves). However, some general determinates can be postulated: FADs provide a guaranteed location of fish although the size of the schools associated with FADs can vary considerably. New electronic buoys with sonar devices can better indicate the volume or biomass of tuna held by a FAD. In times of high relative fuel prices, FADs may provide a risk-adverse option for vessel operators. FAD sets that yield no tuna are typically limited while free unassociated sets have a much higher likelihood of sets with little or no catch. FADs provide a source of fish that may or may not be economic to operators – especially those that offload to canneries. Small skipjack along with juvenile yellowfin and bigeye tuna are very often associated with FADs or floating objects – however, not all fleets or operators can find markets for "small fish," especially when ex-vessel price is low or fish demand is reduced. But in times of high fish demand when canneries are not rejecting fish based on size, FAD fishing can present an attractive scenario for many operators. On the other hand, although skipjack is the main target of the WCPO fishery, yellowfin tuna can provide an important component to vessel profitability given there is typically a premium paid for larger yellowfin, which are typically found in unassociated schools. Operators may be willing to search for these unassociated schools if fuel price is reasonable and larger unassociated fish schools can be found.

Figure 5: FAD sets as proportion of all sets by U.S. WCPO purse seine fleet, 1997-2013.

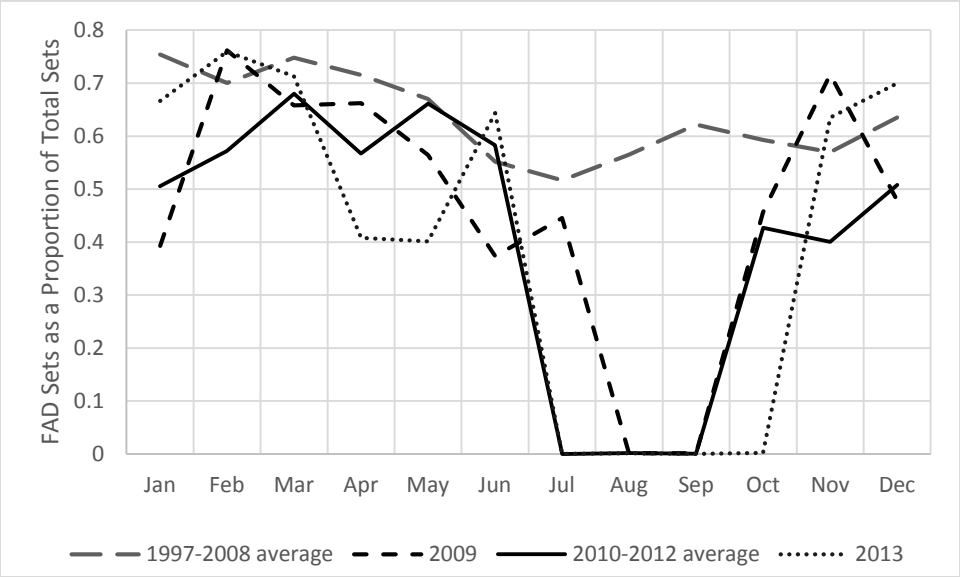


Source: NMFS unpublished data.

Figure 6 below shows FAD sets as a proportion of all sets by the U.S. WCPO purse seine fleet, by month, for the periods 1997-2008 and 2009, 2010-2012, and 2013. FAD restrictions pursuant to WCPFC CMMs were in effect in August and September in 2009, from July through September in 2010-2012, and July-October in 2013. As shown in Figure 7 below, over 70 percent of the U.S. purse seine fleet in the WCPO fished throughout the entire year from 1997 through 2008 and at least that in each of the years from 2009 through 2013. The percent of

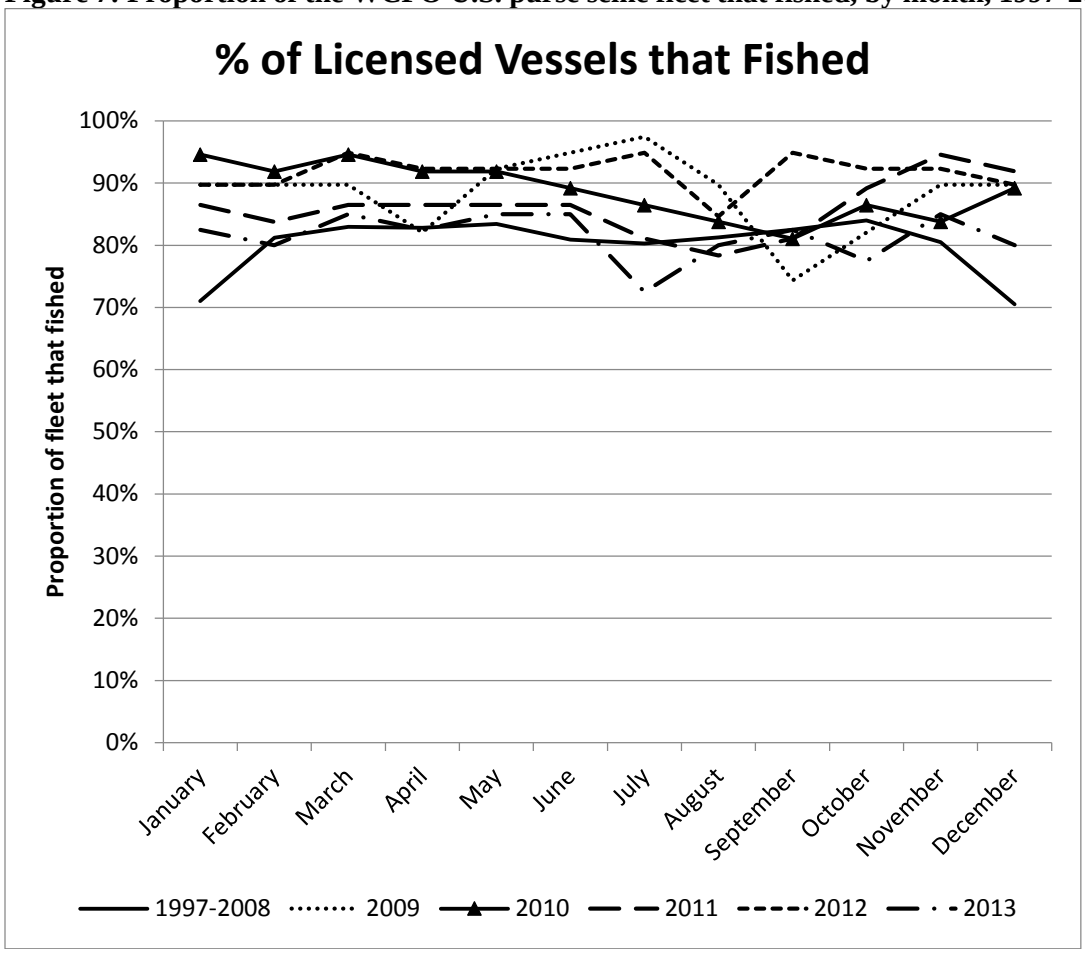
licensed vessels that fished in the years when the 2009-2013 FAD restrictions were in effect was generally constant throughout the year.

Figure 6: FAD sets as proportion of all sets by U.S. WCPO purse seine fleet, by month, 1997-2008 average, 2009, 2010-2012 average and 2013



Source: NMFS unpublished data.

Figure 7: Proportion of the WCPO U.S. purse seine fleet that fished, by month, 1997-2013.



Source: NMFS unpublished data.

Table 5 shows fishing patterns in the fishery in the U.S. WCPO purse seine fishery in 2010-2013. The FAD set ratio averaged 39 percent in those four years. The FAD set ratio during those periods when FAD setting was allowed (that is, not during the seasonal FAD closures) averaged 58 percent in those four years. Table 6 shows the number of total sets and FAD sets made by the fleet from 1997-2013 by area of operation.

Table 5: Total sets, FAD sets, and fishing days in the U.S. WCPO purse seine fishery, 2010-2013.

	Total sets	FAD sets	FAD set ratio	FAD set ratio when FAD sets allowed	Fishing days	Sets per fishing day
2010	8,640	2,356	27%	59%	8,110	1.07
2011	6,295	3,388	54%	67%	7,828	0.80
2012	8,704	3,344	38%	52%	8,473	1.03
2013	7,699	2,958	38%	54%	7,707	1.00
2010-2013 ave	7,835	3,012	39%	58%	8,030	0.97

Source: NMFS unpublished data.

Table 6: Total sets and FAD sets in the U.S. EEZ, on the high seas and in EEZs of other PICs, 1997-2013.

Year	All Sets			FAD Sets		
	U.S. EEZ	High Seas	PIC	U.S. EEZ	High Seas	PIC
1997	1,404	1,063	3,207	626	555	1,985
1998	435	1,392	3,030	43	570	1,959
1999	164	838	2,411	156	807	2,297
2000	74	691	2,901	69	496	1,882
2001	206	676	3,175	112	479	1,426
2002	356	1,046	3,366	37	368	1,273
2003	102	490	2,574	77	319	1,177
2004	166	592	1,890	52	484	1,489
2005	80	579	1,728	61	349	909
2006	154	384	1,441	107	303	1,177
2007	35	579	1,395	33	420	925
2008	30	1,414	5,114	30	643	1,983
2009	96	1,664	6,517	33	684	2,946
2010	15	327	8,298	10	143	2,203
2011	24	398	5,873	13	219	3,156
2012	159	1,290	7,255	68	277	2,999
2013	90	699	6,910	68	479	2,411

Source: NMFS unpublished data.

3.2.5 **Economics**

The fish caught by the U.S. WCPO purse seine fleet are frozen on board and either delivered directly to canneries or transshipped to carriers that deliver them to canneries. Deliveries are made to canneries in both the United States (Pago Pago, American Samoa) and other nations, and those canneries take deliveries from both U.S. vessels and vessels of other nations. The canned product then enters global markets.

Costs and revenue estimates on a per vessel basis for the U.S. WCPO purse seine fleet in 1998 based out of American Samoa are summarized in Table 7. The 1998 gross revenue per vessel of $4.7 million given in that table is equal to about $6.7 million in 2015 dollars (Consumer Price Index, http://www.bls.gov/CPI/). Detailed cost and revenue data for the years since 1998 are not available.

Table 7: Per vessel economics of the U.S. purse seine fleet based in American Samoa in 1998 (1998 dollars)

Component	Annual Value (1000 $U.S.)	% of Total Costs
Gross Revenue	$4,700	—
Fixed Costs	$2,557	57
Variable Costs	$1,921	43
Labor Costs	$1,055	24
Fuel	$700	16
Total Costs	$4,478	100
Net Revenue / Income	$222	—

Source: McCoy and Gillet 1998.

In 2014, average gross registered tonnage among the vessels in the fleet was 1,581 and average vessel length was 66 meters (U.S. Coast Guard Vessel Documentation Database at https://cgmix.uscg.mil/PSIX/PSIXSearch.aspx). Vessels in the U.S. fleet can carry approximately 1,000-2000 mt (U.S. Coast Guard Vessel Documentation Database), depending on the mix and sizes of species in the catch.

Historically, most of the U.S. WCPO purse seine fleet operated out of Pago, Pago, American Samoa. However, recently some of the vessels that have entered the fleet operate under a different business model, and transship most of their catch in Pacific Island ports in the region.

3.3 *WCPO Longline Fisheries*

The U.S. longline fisheries operating in the Convention Area include the Hawaii-based fisheries, which include a tuna-targeting deep-set fishery and swordfish-targeting shallow-set fishery, and the American Samoa-based fishery. There has also been limited longlining activity based in Guam and the Commonwealth of the Northern Mariana Islands (CNMI) (hereafter, the Mariana Islands longline fishery), but due to the small number of vessels in this fishery, data from this fishery is confidential and not described further in this chapter (see 50 CFR 600.425). These longline fisheries are managed under the Pelagics FEP, implemented by regulation at 50 CFR Part 665, as well as by regulations implemented under the WCPFCIA at 50 CFR Part 300 Subpart O. Summaries of management measures for the respective longline fisheries are available on the NMFS Pacific Islands Regional Office Web site.

There is also a small longline fleet based on the U.S. West Coast, managed under the Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species (West Coast HMS FMP), implemented by regulations at 50 CFR Part 660. This fleet has not fished in the Convention Area in recent years and is not expected to do so in the near future, so it is not considered further in this PEA.

3.3.1 **Hawaii-Based Deep-Set and Shallow-Set Longline Fisheries**

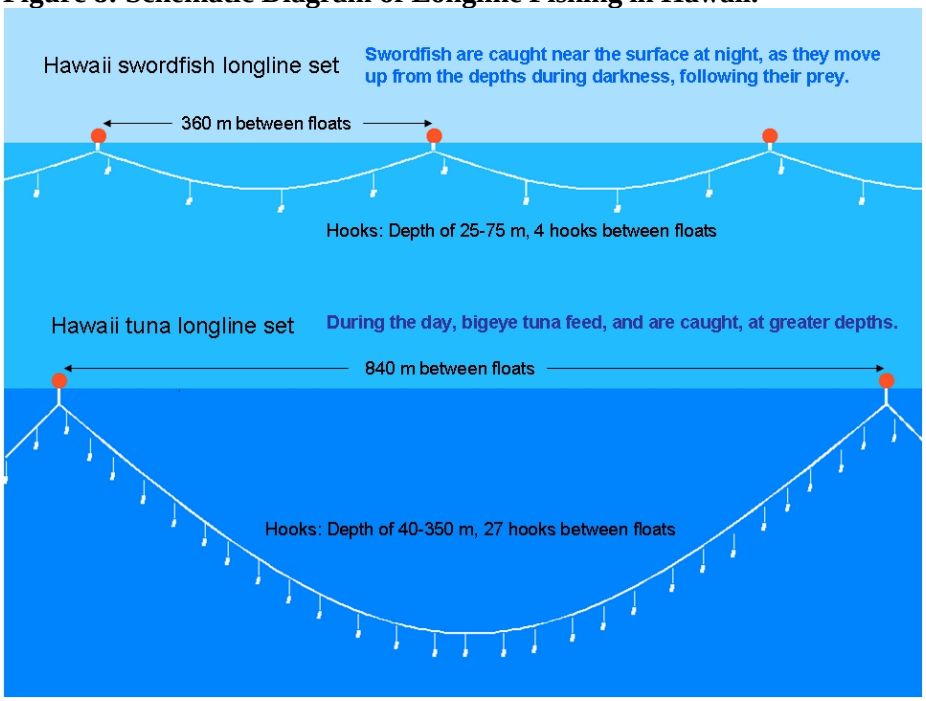
3.3.1.1 Fleet Characteristics

Longline fishing gear consists of a main line strung horizontally, supported at regular intervals by vertical float lines connected to surface floats. Descending from the main line are branch

lines, each ending in a single, baited hook. The main line droops in a curve from one float to the next and bears some number (2-25) of branch lines between floats. Fishing depth is determined by the length of float lines and branch lines, and the amount of sag in the main line between floats. The depth of hooks affects the efficiency at catching different species (Boggs 1992; Hanamoto 1987; Suzuki et al. 1977). Gear retrieval typically requires seven to ten hours. Generally, longline gear targeting tuna is set in the morning at approximate depths ranging between 100-300 meters, and hauled in the evening. Longline gear targeting swordfish is set at sunset at depths less than 100 meters and hauled at sunrise. Figure 8 illustrates typical gear configurations in the shallow-set and deep-set Hawaii-longline fisheries. Western Pacific Regional Fishery Management Council (WPRFMC) 2013 and WPRFMC 2009a provide more detailed descriptions of longline fishing in the WCPO.

The Hawaii-based longline fleet is the largest U.S. longline fleet operating in the Convention Area. The fleet has historically operated, and continues to operate, in two distinct fisheries based on gear deployment: deep-set longline by vessels that target primarily bigeye tuna and shallow-set longline by those that target swordfish (*Xiphias gladius)*. Fishing effort is mainly exercised to the north and south of the Hawaiian Islands between the Equator and 40° N and longitudes 140° W and 180° W. However, the majority of deep-set fishing occurs south of 25° N or 30° N. Most fishing occurs in the U.S. EEZ around Hawaii and in adjacent high seas waters.

Figure 8: Schematic Diagram of Longline Fishing in Hawaii.



Source: NMFS Pacific Islands Fisheries Science Center

3.3.1.2 Management

The Hawaii-based longline fisheries are managed under the Pelagics FEP. Regulations for the management of these fisheries are set forth at 50 CFR Part 665. A summary of management

measures is provided in the Hawaii longline regulations summary, which is available on the NMFS Pacific Islands Regional Office Web site.[15] The HSFCA and the WCPFCIA also regulate this fishery. The following is a summary of the primary regulations for these fisheries. Requirements for both Shallow-Set and Deep-Set Longline Fisheries:

Required Permits and Certificates

- Hawaii Longline Limited Access Permit
- State of Hawaii Commercial Marine License
- HSFCA Permit (if fishing outside of the U.S. EEZ)
- WCPFC Area Endorsement (if fishing in the Convention Area)
- Marine Mammal Authorization Program Certificate
- Protected Species Workshop Certificate
- Western Pacific Receiving Vessel Permit (if applicable)

Required Reporting and Identification

- NMFS Western Pacific Daily Longline Fishing Log
- NMFS Transshipment Log Reports
- Marine Mammal Authorization Program Mortality/Injury Reporting Forms
- VMS must be carried and used
- Vessel Identification international radio call sign or official number must be displayed on hull and deck
- Gear Identification all gear must carry vessel's official number

Observer Requirements

- All vessels must notify the NMFS observer program 72 hours before departing on a fishing trip and declare the intended trip type (shallow-set or deep-set)
- Vessels must carry a NMFS observer if assigned. Currently observer coverage levels are: 100% in the shallow-set Hawaii longline fishery and 20% in the deep-set Hawaii longline fishery.

Protected Resources

- Specific training regarding protected resources; equipment for releasing commonly encountered protected species such as sea turtles, seabirds, and marine mammals are required on all vessels
- Sharks may be landed, but must retain all fins, naturally attached
- Oceanic whitetip sharks and silky sharks may not be retained on board and must be released as soon as possible when caught

[15] http://www.fpir.noaa.gov/

Gear and Setting Requirements

Deep set fishing

- No light sticks may be on board vessels
- Swordfish limits if the trip does not have an observer
- Specific mitigation measures for seabirds must be used

Shallow set fishing

- Sea turtle interaction limits are in place (34 per year for loggerhead turtles and 26 per year for leatherback turtles)
- Mackerel type bait should be used, no squid use for bait
- Larger circle hooks must be used
- Specific mitigation measures for seabirds must be used

3.3.1.3 Catch and Effort

Table 8 and Table 9 show the performance of the Hawaii-based deep-set longline fishery and Hawaii-based shallow-set longline fishery from 2000-2014. Figure 9, Figure 10, and Figure 11 show the retained catch of bigeye tuna and swordfish in the fisheries, by month in the years 2005-2014.

Table 8: Hawaii-based deep set longline fishery performance factors in the WCPFC area, 2000-2014

Year	Active Vessels	Number of Sets	Total Hooks Set	Total Retained Catch (mt)	Bigeye tuna retained catch (mt)	Swordfish retained catch (mt)	Yellowfin tuna retained catch (mt)	Albacore retained catch (mt)
2000	79	8,800	17,051,986	5,480	2,293	53	988	845
2001	100	11,363	21,424,448	6,616	2,264	90	971	1,249
2002	102	13,431	26,022,336	7,336	4,222	184	425	516
2003	110	14,320	28,715,053	7,644	3,396	131	810	523
2004	125	15,336	30,661,713	8,001	4,175	154	696	352
2005	124	15,436	31,248,838	8,102	4,415	158	691	282
2006	127	16,304	34,263,296	8,540	4,306	176	933	254
2007	129	16,660	36,181,759	8,857	5,305	195	824	237
2008	127	15,307	34,100,313	8,398	4,591	239	816	296
2009	127	14,577	32,682,233	6,833	3,865	181	432	175
2010	120	12,316	28,452,663	6,885	4,042	167	504	363
2011	127	14,274	33,671,822	8,607	4,617	158	865	602
2012	127	15,880	38,378,490	9,013	4,975	212	836	589
2013	135	14,637	36,243,864	8,188	4,432	206	683	296
2014	137	15,961	40,318,674	8,708	5,047	215	587	185

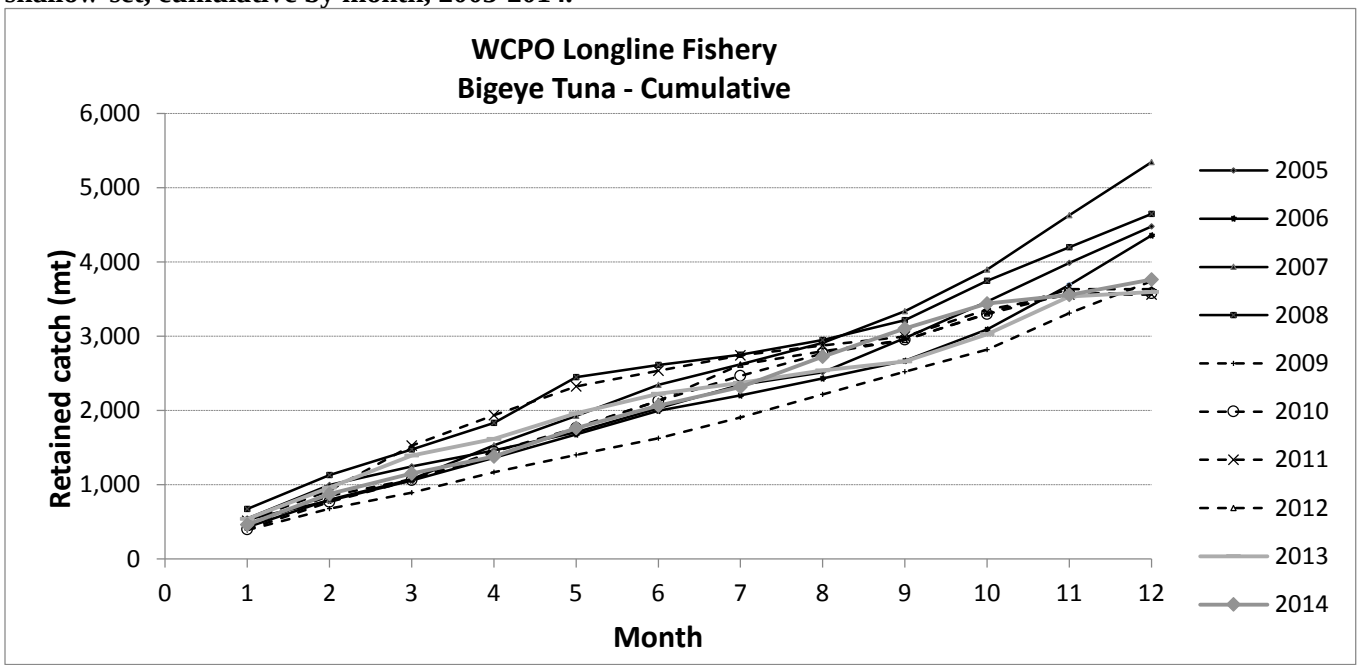
Source: U.S. data submitted to the WCPFC. This table represents total amount of bigeye tuna catch landed by the Hawaii-based longline fleet, including catch attributed to the U.S. Participating Territories

Table 9: Hawaii-based shallow set longline fishery performance factors in the WCPFC area, 2000-2014

Year	Active Vessels	Number of Sets	Total Hooks Set	Total Retained Catch (mt)	Bigeye tuna retained catch (mt)	Swordfish retained catch (mt)	Yellowfin tuna retained catch (mt)	Albacore retained catch (mt)
2000	57	3,161	2,397,687	2,816	283	1,867	154	41
2001	22	542	492,015	287	74	72	17	16
2002	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0
2004	3	15	11,200	15	0	15	0	0
2005	31	1,452	1,226,414	1,549	65	1,291	10	8
2006	35	821	683,127	1,021	54	940	4	6
2007	27	1,283	1,130,515	1,335	41	1,222	6	10
2008	26	1010	959,489	1,253	58	1,043	25	6
2009	28	1346	1,325,226	1,213	32	1,067	11	8
2010	27	1252	1,240,276	986	42	866	10	7
2011	20	829	867,812	836	34	701	17	6
2012	17	823	901,335	786	24	688	12	3
2013	10	435	478,043	459	18	376	10	3
2014	18	619	691,755	737	14	665	20	1

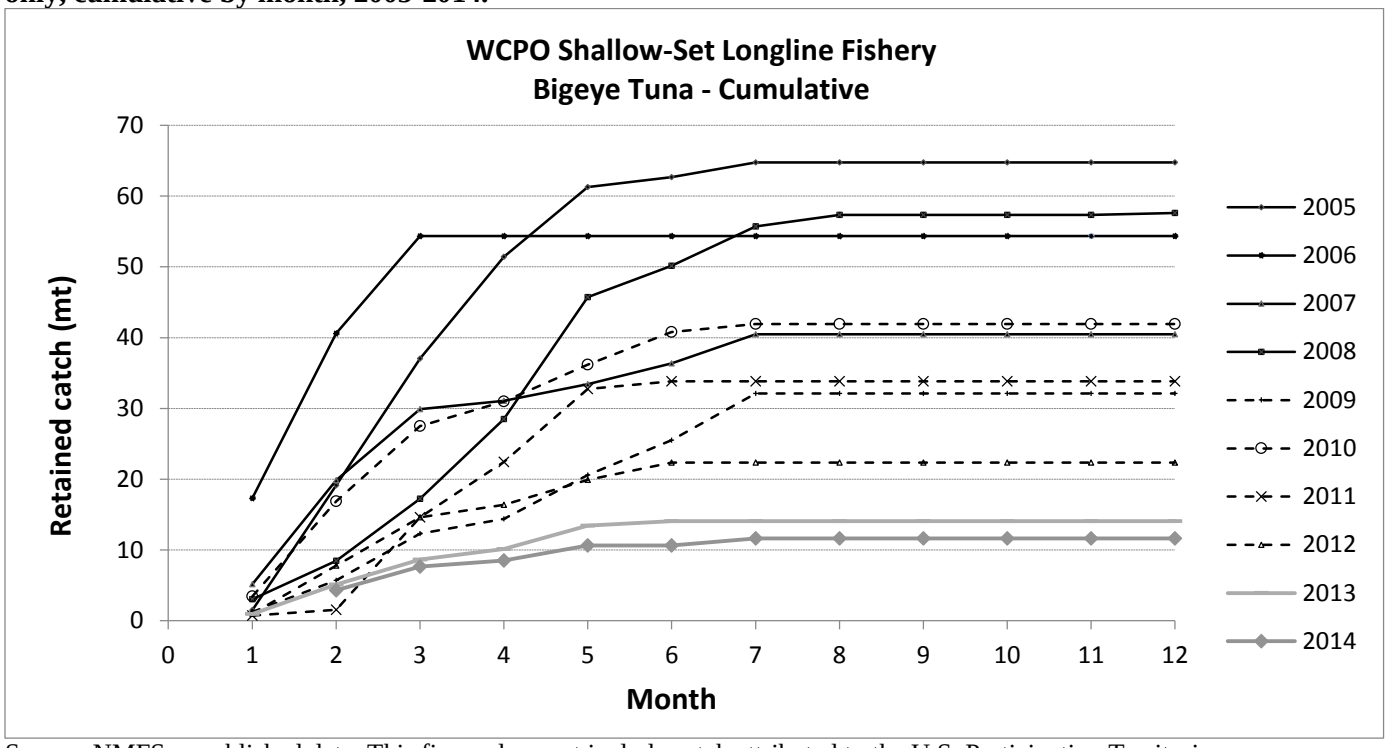
Source: U.S. data submitted to the WCPFC. This table represents total amount of bigeye tuna catch landed by the Hawaii-based longline fleet, including catch attributed to the U.S. territories participating in the WCPFC (American Samoa, Guam, or the CNMI, collectively U.S. Participating Territories).

Figure 9: Estimates of bigeye tuna kept in the U.S. longline fisheries, WCPO only, deep-set and shallow-set, cumulative by month, 2005-2014.



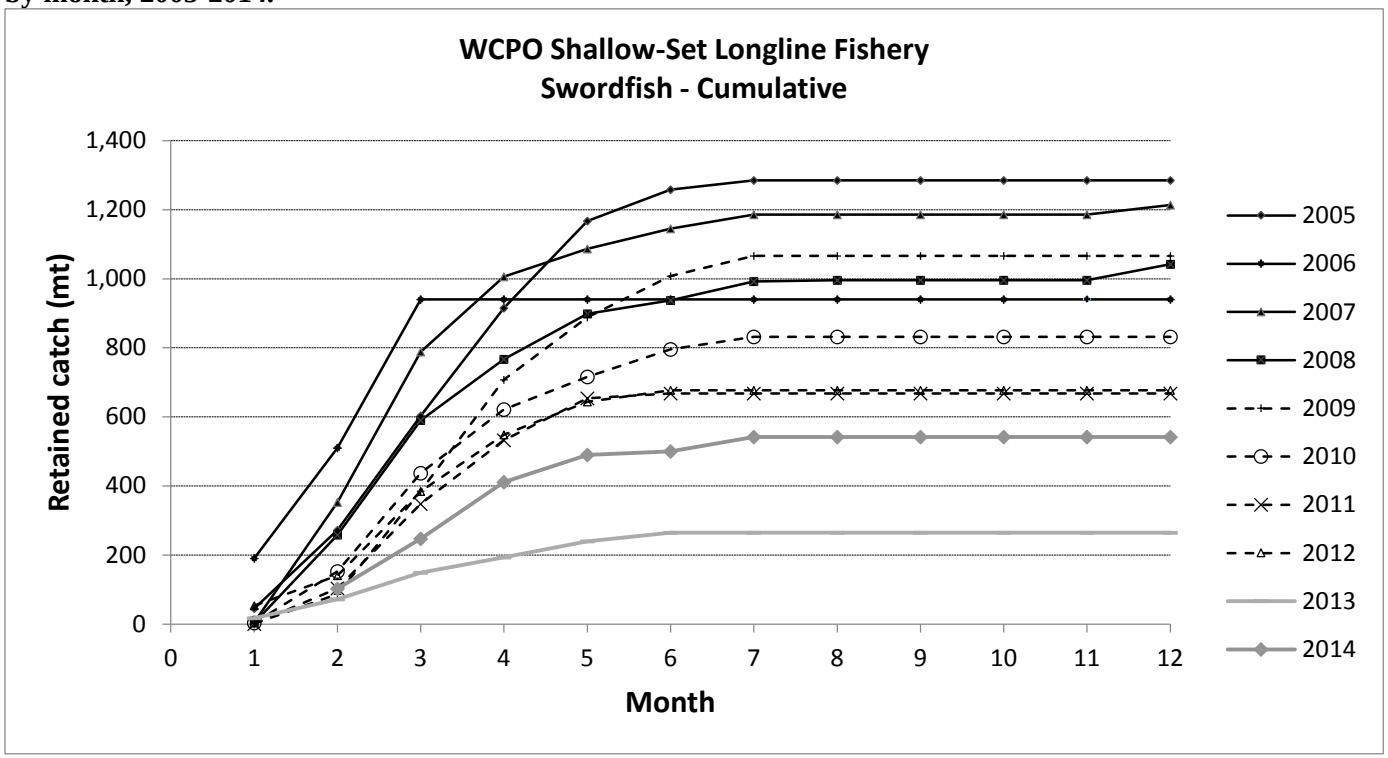
Source: NMFS unpublished data. This figure does not include catch attributed to the U.S. Participating Territories.

Figure 10: Estimates of bigeye tuna kept in the U.S. longline fisheries, WCPO only, shallow-set only, cumulative by month, 2005-2014.



Source: NMFS unpublished data. This figure does not include catch attributed to the U.S. Participating Territories.

Figure 11: Estimates of swordfish kept in U.S. shallow-set longline fishery, WCPO only, cumulative by month, 2005-2014.



Source: NMFS unpublished data.

3.3.1.4 Economics

As of March 2015, the U.S. Hawaii-based longline fleet consisted of 131 permitted (under the FMP) vessels.[16] Out of the 131 permitted vessels, all 131 also have a high seas fishing permit (issued under the HSFCA). Vessels range from 14 meters to 30 meters in length and can carry an average of 115 mt. Crew size ranges from four to nine. The maximum duration of a fishing trip for vessels targeting tuna for the fresh fish market in Hawaii is three weeks. Some of the newer vessels in the fleet are larger and have onboard ice systems, allowing for greater range than in the past (NMFS unpublished data).

In 2012, the most recent year for which published data is available, the ex-vessel value for the landings of the deep-set fishery was approximately $86.5 million and the ex-vessel revenue for the shallow-set fishery was approximately $5.8 million (WPRFMC 2014).

3.3.2 **American Samoa Longline Fishery**

3.3.2.1 Fleet Characteristics

This fishery has two discrete components based on vessel size and fishing technology: small-scale vessels, 40 feet (12.2 meters) or less in length, generally fishing within 25 nautical miles from shore (i.e., the "*alia* fleet"); and larger monohull vessels, mostly over 50 feet (15.2 meters) in length, fishing throughout and beyond the U.S. EEZ. The entry of numerous large (>15 meters) longline vessels in the early 2000s resulted in a dramatic increase in longline fishing effort as well as a shift of fishing effort in waters between 50 and 200 nautical miles from shore. On average, the smaller vessel *alia* fleet has three person crews, while the large vessel fleet generally has six person crews. Currently, the American Samoa longline fleet can be characterized as primarily a large vessel fleet. In order to reduce the potential for gear conflicts and catch competition, there are area closures for large vessels.

3.3.2.2 Management

The American Samoa Longline Limited Entry Program is managed under the Pelagics FEP. The regulations implementing the program are codified at 50 CFR 665.816. The American Samoa Longline Limited Entry Program allows for as many as 60 vessels. Permits are issued by vessel size class and permit holders are restricted to using vessels within their size class or smaller. The class sizes are as follows: Class A vessels are 40 feet long or smaller; Class B (and B-1) vessels are longer than 40 feet, but no longer than 50 feet; Class C (and C-1) vessels are longer than 50 feet, but no longer than 70 feet; and Class D (and D-1) vessels are longer than 70 feet.[17]

[16] Data as of March 2015.

[17] Class A vessels are 12.2 meters or less; Class B (and B-1) vessels are longer than 12.2 meters, but no longer than 15.2 meters; Class C (and C-1) vessels are longer than 15.2 meters, but no longer than 21.3 meters; and Class D (and D-1) vessels are longer than 21.3 meters.

Required Permits and Certificates

- American Samoa Longline Limited Entry Permit
- HSFCA Permit (if fishing outside of the U.S. EEZ)
- WCPFC Area Endorsement (if fishing in the Convention Area)
- Marine Mammal Authorization Program Certificate
- Protected Species Workshop Certificate
- Western Pacific Receiving Vessel Permit (if applicable)

Required Reporting and Identification

- NMFS Western Pacific Daily Longline Fishing Log
- NMFS Transshipment Log Reports
- Marine Mammal Authorization Program Mortality/Injury Reporting Forms
- VMS must be carried and used
- Vessel Identification – international radio call sign or official number must be displayed on hull and deck
- Gear Identification- all gear must carry vessel's official number

Observer Requirements

- All vessels must notify the NMFS observer program 72 hours before departing on a fishing trip
- Vessels must carry a NMFS observer if assigned. Currently observer coverage levels are 20% in the American Samoa longline fishery.

Protected Resources

- Specific training regarding protected resources; equipment for releasing commonly encountered protected species such as sea turtles, seabirds, and marine mammals are required on all vessels
- Sharks may be landed, but must retain all fins, naturally attached
- Oceanic whitetip sharks and silky sharks may not be retained on board and must be released as soon as possible when caught
- No commercial fishing within 50 nautical miles of marine national monuments

Gear and Setting Requirements

- Vessels larger than 40 feet must follow specific requirements to reduce sea turtle interactions when fishing north of the Equator
- No more than 10 swordfish per trip may be kept or landed

3.3.2.3 Catch and Effort

Albacore (*Thunnus alalunga*) continued to dominate the catch of pelagic species in 2014. Table 10 shows catch and effort information from 2000-2014.

Table 10: American Samoa-based longline fishery performance factors in the Convention Area, 2000-2014.

Year	Active Vessels	Number of Sets	Hooks Set	Retained Catch (mt)	Albacore retained catch (m)	Bigeye tuna retained catch (mt)	Swordfish retained catch (mt)	Yellowfin tuna retained catch (mt)
2000	37	2,805	1,330,244	789	609	25	1	83
2001	62	4,800	5,795,241	3,880	3,416	79	10	183
2002	58	6,872	13,095,625	7,118	5,959	196	17	469
2003	50	6,220	14,165,172	5,222	3,984	253	14	559
2004	41	4,853	11,741,900	4,080	2,498	231	10	853
2005	36	4,359	11,128,976	4,016	2,906	141	8	533
2006	31	5,068	14,261,259	5,502	4,212	205	39	478
2007	29	5,919	17,551,551	6,474	5,181	218	13	640
2008	29	4,754	14,444,331	4,388	3,561	132	7	336
2009	26	4,907	15,067,775	4,830	3,903	161	13	386
2010	26	4,534	13,174,655	4,888	3,943	178	11	445
2011	24	3,775	10,767,752	3,341	2,291	178	12	555
2012	25	4,099	11,800,893	4,082	3,147	164	14	348
2013	22	3,405	10,165,868	2,744	2,128	84	11	390
2014	22	2,739	7,646,128	2,109	1,448	82	10	426

Source: U.S. data submitted to the WCPFC; Number of Vessels from 2000-2007 derived from Table 18 of WPRFMC 2014.

3.3.2.4 Economics

Total revenue for the American Samoa longline fishery in 2012 was approximately $9.7 million, dominated by albacore revenue (almost $7.7 million) (WPRFMC 2014).

3.4 *Convention Area HMS Fisheries*

The dominant HMS fisheries in the Convention Area are tuna fisheries that target skipjack tuna, yellowfin tuna, bigeye tuna, and albacore. Many distant-water fishing nations and coastal states participate in the fisheries and operations vary from small-scale, subsistence, and artisanal operations in the coastal waters of Pacific Island States, to industrial scale operations both in the EEZs of Pacific Island States and on the high seas.

HMS fisheries in the Convention Area are managed under a number of international agreements and associated domestic authorities. Catch and effort information is compiled by the OFP at SPC as the scientific and data support provider to the Commission for most fisheries. The WCPFC Tuna Yearbook, produced by the Oceanic Fisheries Programme (OFP) at SPC, summarizes this information and is available to the public.[18]

The provisional total Convention Area tuna catch for 2013 was estimated to be 2,621,511 mt, the second highest on record (Williams and Terawasi 2014).

3.5 *Target Species*

Table 11 shows the U.S. official designation of the current status of the main target stocks in the fisheries that would be affected by the proposed rule.

Table 11: Stock status summary of main target HMS for U.S. longline fleets in the Pacific Ocean

Species	Stock	Overfishing?	Overfished?
Albacore (*Thunnus alalunga)*	North Pacific	No	No
	South Pacific	No	No
Bigeye tuna (*Thunnus obesus)*	Pacific	**Yes**	No
Skipjack tuna *(Katsuwonus pelamis)*	Western and Central Pacific	No	No
	Eastern Pacific	No	No
Swordfish *(Xiphias gladius)*	North Pacific	No	No
Yellowfin tuna (*Thunnus albacares)*	Western and Central Pacific	No	No
	Eastern Pacific	No	No

Source: http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/status_updates.html

As shown in Table 11 above, using the MSA stock status determination criteria, overfishing is occurring on bigeye tuna throughout the Pacific but the bigeye tuna stock is not overfished. The following sections provide more information on each of the target species.

3.5.1 **Albacore *(Thunnus alalunga*)**

Longlining is one of the main fishing methods that target albacore. Longliners tend to catch larger individual fish at lower latitudes (Gillet and Langley 2007).

Information suggests that separate northern and southern stocks of albacore, with separate spawning areas and seasons exist in the Pacific. Temperature plays a large role in the distribution of the species. In the North Pacific, albacore are distributed in a swath centered on 35° N and range as far as 50° N at the western end of their range. In the central South Pacific (150° E to 120° W) they are concentrated between 10° S and 30° S; in the west they may be found as far south as 50º S. They are absent from the equatorial eastern Pacific. Albacore are both surface-dwelling and deep-swimming. Deep-swimming albacore are generally more concentrated in the western Pacific but with eastward extensions along 30° N and 10° S (Foreman 1980). The 15.6°

[18] See http://www.wcpfc.int/statistical-bulletins.

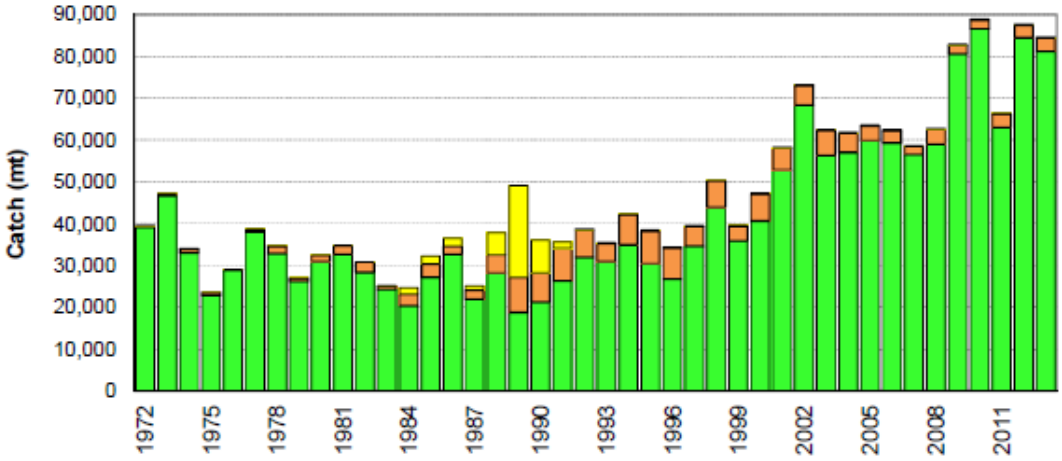
to 19.4° C sea surface temperature (SST) isotherms mark the limits of abundant distribution although deep-swimming albacore have been found in waters between 13.5° and 25.2° C (Saito 1973). Laurs and Lynn (1991) describe North Pacific albacore distribution in terms of the North Pacific Transition Zone, which lies between the cold, low salinity waters north of the sub-arctic front and the warm, high salinity waters south of the sub-tropical front. This band of water, roughly between 40° and 30-35° N (the zone is not a stable feature) also helps to determine migration routes. Albacore are found to a depth of at least 38 meters and will move into water as cold as 9° C at depths of 200 meters.

Albacore follow complex migration patterns that differ between the North and South Pacific stocks. Most migration is undertaken by pre-adults between two and five years old. A further sub-division of the northern stock, each with separate migration routes, is also suggested. Generally speaking, a given year class migrates east to west and then east again in a band between 30° N and 45° N, leaving the northeast Pacific in September-October, reaching waters off Japan the following summer and returning to the east in the summer of the following year. In the South Pacific Ocean, mature albacore spawn in tropical and sub-tropical waters between about 10° S and 25° S during the austral summer. Spawning success appears to be related to the prevailing oceanographic conditions with stronger recruitment occurring during La Niña conditions (i.e., positive Southern Oscillation Index) (Langley 2006). Juvenile albacore recruit to surface fisheries in New Zealand coastal waters and in the vicinity of the sub-tropical convergence zone (about 40° S) in the central Pacific about one year later, at a size of 45-50 centimeters (fork length).

Albacore are noted for their tendency to concentrate along thermal fronts, particularly the Kuroshio front east of Japan and the North Pacific Transition Zone. Laurs and Lynn (1991) note that they tend to aggregate on the warm side of upwelling fronts. Near continental areas they prefer warm, clear oceanic waters adjacent to fronts with cool turbid coastal water masses. Further offshore, fishing success correlates with biological productivity found a converging ocean mass or fonts cited above.

Figure 12 displays albacore catch in the Convention Area by gear type.

Figure 12: Convention Area albacore catch (mt) by gear 1972-2013. Green indicates longlining, orange is troll fishing, yellow is the driftnet fishery (closed in 1991).



Source: Williams and Terawasi 2014.

3.5.2 **Bigeye Tuna (*Thunnus obesus*)**

Several studies on the taxonomy, biology, population dynamics, and exploitation of bigeye tuna have been carried out, including comprehensive reviews by Collette and Nauen (1983), and Whitelaw and Unithan (1997). Miyabe (1994) and Miyabe and Bayliff (1998) reviewed the biology and fisheries for bigeye tuna in the Pacific Ocean.

This species is a mixture between a tropical and temperate water tuna, characterized by equatorial spawning, high fecundity, and rapid growth during the juvenile stage with movements between temperate and tropical waters during its life cycle. Bigeye tuna are trans-Pacific in distribution, occupying epipelagic and mesopelagic waters of the Indian, Pacific, and Atlantic Oceans. The distribution of the species within the Pacific stretches between northern Japan and the north island of New Zealand in the western Pacific and from 40° N to 30° S in the eastern Pacific (Calkins 1980). Molecular analyses (Grewe et al. 1998) and tagging projects executed by the SPC (Langley et al. 2008) indicate that a single stock exists for Pacific bigeye tuna, however a tagging study done by Schaefer and Fuller (2009) revealed a low degree of mixing between eastern Pacific and western Pacific groups demonstrating relatively strong regional fidelity.

Matsumoto et al. (2013) conducted a tagging study that showed bigeye also observed some degree of school fidelity. Large, mature-sized bigeye tuna are sought by sub-surface fisheries, primarily longline fleets. Smaller, juvenile fish are taken in many surface fisheries, either as a targeted catch or as a bycatch with other tuna species (Miyabe and Bayliff 1998). Large numbers are taken by purse seiners fishing on FADs in equatorial waters, however these fish tend to be of a smaller size as larger bigeye are less likely to associate with FADs (Schaefer and Fuller 2009).

Basic environmental conditions favorable for survival include clean, clear oceanic waters between 13° C and 29° C. Hanamoto (1987) estimated optimum bigeye habitat to exist in water temperatures between 10° to 15° C at salinities ranging between 34.5 parts per thousand to 35.5

parts per thousand where dissolved oxygen concentrations remain above 1 milliliter/liter. He further suggested that bigeye range from the surface layers to depths of 600 meters. However, evidence from archival tagging studies indicates that greater depths and much lower ambient temperatures can be tolerated by the species. Bigeye do display some diel vertical migration tendencies. They have been observed to stay above the 20° C isotherm all the time when associated with a FAD, but free swimming schools tend to go below the 20° C isotherm during the day and come above it at night (Matsumoto et al. 2013). Juvenile bigeye occupy an ecological niche similar to juvenile yellowfin of a similar size. Preferred water temperature often varies with the size and maturity of pelagic fish. Adults usually have a wider temperature tolerance than sub-adults. Thus, during spawning, adults usually move to warmer waters, the preferred habitat of their larval and juvenile stages

Miyabe and Bayliff (1998) present summary information of some long distance movements of tagged bigeye tuna in the Pacific. Hampton et al. (1998) describe 8,000 bigeye tuna releases made in the western Pacific during 1990-1992. Most of the fish were recaptured close to the point of release; approximately 25 percent had moved more than 200 nautical miles, and more than 5 percent had moved more than 1,000 nautical miles. These migration patterns, along with the boundaries of the two regional fishery management organizations, generally cause stock assessments in the WCPO and EPO to be conducted separately (Langley et al. 2008).

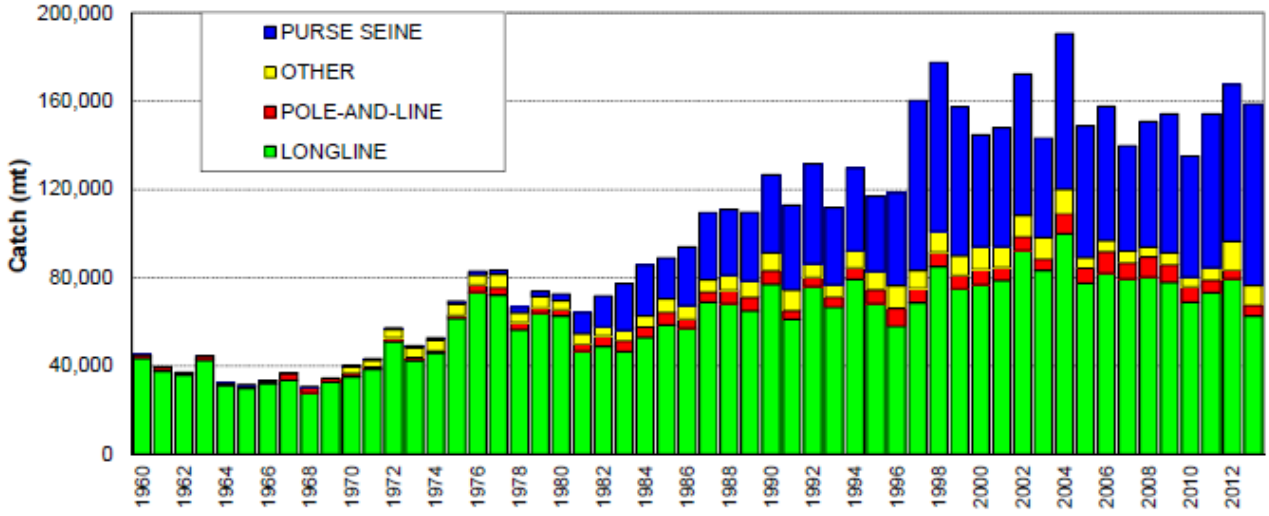
Feeding is opportunistic at all life stages, with prey items consisting primarily of crustaceans, cephalopods, and fish (Calkins 1980). There is significant evidence that bigeye feed at greater depths than yellowfin tuna, utilizing higher proportions of cephalopods and mesopelagic fishes in their diet thus reducing niche competition (Whitelaw and Unithan 1997). Spawning spans broad areas of the Pacific and occurs throughout the year in tropical waters and seasonally at higher latitudes at water temperatures above 23° or 24° C (Kume 1967). Bigeye are serial spawners, capable of repeated spawning at near daily intervals with batch fecundities of millions of ova per spawning event (Nikaido et al. 1991). Sex ratio is commonly accepted to be essentially 1:1 until a length greater than 150 centimeters, after which the proportion of males increases. Alverson and Peterson (1963) state that juvenile bigeye less than 100 centimeters generally feed at the surface during daylight, usually near continental land masses, islands, seamounts, banks, or floating objects. Bigeye tuna are moderately fast growing, reaching maturity between the ages of two and a half and six years. A recapturing study suggests that a large proportion of bigeye reach the age of eight, with some surviving to at least sixteen years (Langley et al. 2008).

Bigeye tuna, especially during the juvenile stages, aggregate strongly to drifting or anchored objects, large marine animals, and regions of elevated productivity, such as near seamounts and areas of upwelling (Calkins 1980; Hampton and Bailey 1993; Holland et al. 1999). Major fisheries for bigeye tuna exploit aggregation effects either by targeting biologically productive areas (deep and shallow seamount and ridge features) or by utilizing artificial FADs to aggregate commercial concentrations of bigeye tuna. Juvenile and pre-adult bigeye of 35 centimeters to approximately 99 centimeters are regularly taken as bycatch in the eastern and western Pacific purse-seine fisheries, usually on FAD sets (Hampton and Bailey 1993). Juvenile bigeye tuna form mono-specific schools at or near the surface with similar-sized fish or may be mixed with skipjack and/or juvenile yellowfin tuna (Calkins 1980; Holland et al. 1999). Juvenile and adult

bigeye tuna are also known to aggregate near seamounts and submarine ridge features where they are exploited by pole-and-line, handline, and purse seine fisheries (Fonteneau 1991; Holland et al. 1999).Small bigeye are caught near the surface by purse seines, while larger fish are caught deeper using longline gear (Gillett and Langley 2007).

In 2013, the estimated total bigeye catch in the WCPO was 158,662 mt, lower than in 2012, but stable compared to the ten year average (Williams and Terawasi 2014). Figure 13 below shows the catch of bigeye tuna in the Convention Area from 1960-2013 by gear type.

Figure 13: Convention Area bigeye tuna catch (mt) by gear 1960-2013



Source: Williams and Terawasi 2014.

3.5.3 Skipjack Tuna *(Katsuwonus pelamis)*

Skipjack tuna are concentrated mostly in tropical waters; though they also seasonally expand into subtropical waters in both the north and south Pacific.

They can tolerate a temperature range of 15° C to 33° C, but they are more commonly found in waters above 20° C (Dizon et al. 1977). The main characteristics of skipjack tuna are fast growth, early maturity (ten months to one year), high fecundity, year-round spawning (Hunter et al. 1986) over broad tropical regions, a relatively short life span compared to bigeye, albacore, and bluefin tunas, high and variable recruitment and few age classes on which the fishery depends.

CPUE trends for purse seiners dramatically rose between 2004 and 2007 before fluctuating until 2009. Post 2009 trends have been generally downward through 2011, but have not dipped much below 2005 levels (Harley et al. 2012).

In 2013, the estimated total skipjack catch in the WCPO was 1,784,091 mt, the highest recorded. The purse seine fishery was responsible for the bulk of this catch (Williams and Terawasi 2014).

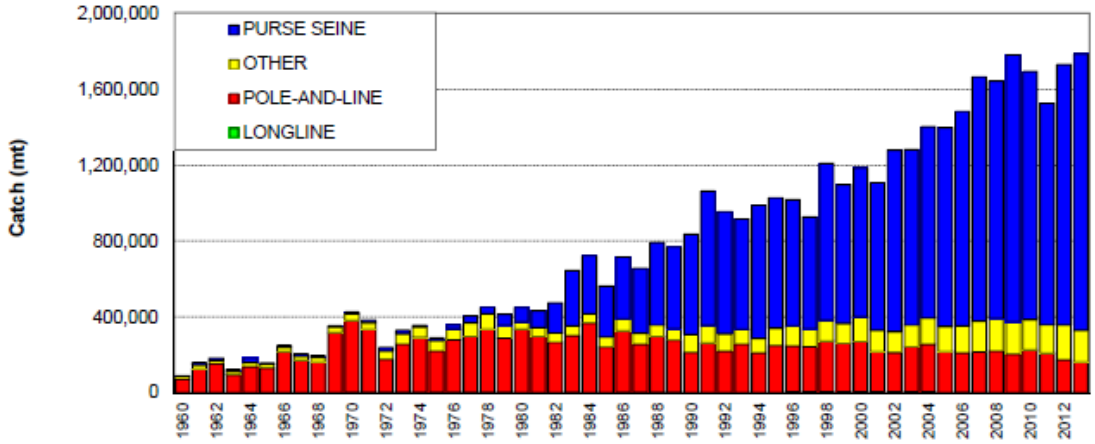
Historically, bait boats (pole-and-line) were the main gear used in catching skipjack tuna but since the 1950s, purse seiners have come to dominate the fishery. Some skipjack tuna are also caught incidentally by longliners, particularly those using shallow gear (typically hooked when retrieving the gear). In the WCPO, fishing for skipjack tuna occurs in the waters of a number of island nations and is carried out by both small domestic fleets and distant water fleets from developed nations.

Genetic studies of the Pacific population of skipjack tuna suggest that some mixing of fish occurs across the Pacific Ocean, but for management purposes, the stocks in the western Pacific have been considered by most scientists to be independent of those in the eastern Pacific. Tagging data showing limited movement of skipjack from the eastern Pacific to the western Pacific support the same conclusion (Joseph 2003). Recent research suggests that fast-growing, short-lived species like skipjack and yellowfin may have median lifetime displacements on the order of 644–805 kilometers, supporting the idea of "regional fidelity" (Sibert and Hampton 2003). Remote sensing has corroborated this data. Like bigeye, skipjack tuna also displays diel vertical migrations especially in relation to FADs. A tagging study done by Matsumoto et al. (2014) showed that skipjacks' swimming depth was deeper during the day than at night, a pattern that was more obvious when they were not associated with a FAD. Those swimming with a FAD still showed some vertical migration patterns, but they were not as pronounced.

Studies of skipjack in the North Pacific have also demonstrated north-south migrations, seeming to primarily follow sea surface temperature, with some influence from sea surface chlorophyll, and physical ocean features like currents, fronts and eddies (Mugo et al. 2010). The possibility of restricted movements of skipjack in the WCPO suggests the possibility for local depletion despite the large total biomass. There is some evidence that skipjack tuna have migrations tied to ENSO events however this migration can be interrupted if they encounter FADs along the way. FAD placement could retain skipjack tuna in areas they would not normally colonize and change how they interact with their environment (Wang et al. 2014).

Figure 14 below shows the Convention Area skipjack tuna catch by gear type.

Figure 14: Convention Area skipjack tuna catch (mt) by gear 1960-2013



Source: Williams and Terawasi 2014.

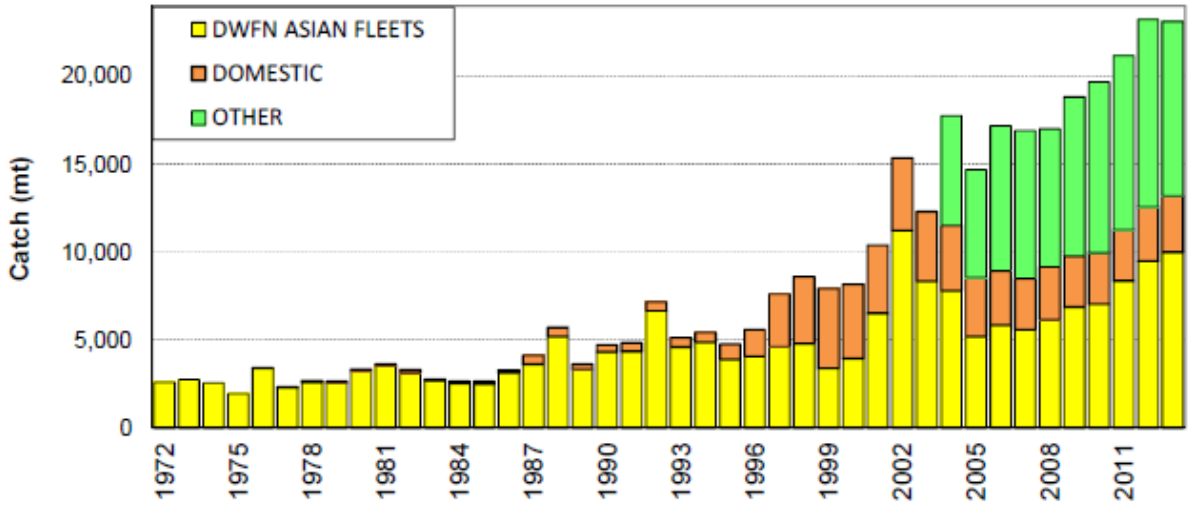
3.5.4 **Swordfish (*Xiphias gladius*)**

The biology of swordfish is covered in some detail by prior analysis by NMFS (2005). Ward and Elscot (2000) also authored an extensive review of the biology of swordfish and status of swordfish fisheries around the world.

Information on the age and growth of swordfish is the subject of intense study, and findings have been somewhat contradictory. Age studies based on otolith analysis and other methods (length, frequency, vertebrae, fin rays, inter alia) are reviewed by Ehrhardt et al. (1996). Wilson and Dean (1983) estimated a maximum age of nine years for males and 15 years for females from otolith analysis. Larvae and juveniles occur in warmer tropical and subtropical regions where spawning also occurs. Swordfish have separate sexes with no apparent sexual dimorphism, although females attain a larger size. Fertilization is external and the fish are believed to spawn close to the surface. Maturity is thought to occur between four and five years for females and between 3 and four years for males. In the equatorial Pacific spawning occurs year round; in the north Pacific it occurs in the warmer months of March through July (NMFS SWFSC 2014).

Swordfish are worldwide in distribution in all tropical, subtropical, and temperate seas, ranging from around 50° N to 50° S (Nakamura 1985). Swordfish are found in waters with a wide range of SSTs, from 5°-27° C, but are normally found in areas with SSTs above 13° C (Nakamura 1985). Archival tagging experiments indicate that they spend prolonged periods in deep, cooler water and can therefore tolerate water temperatures that are considerably cooler than at the surface (Takahashi et al. 2003). Studies have noted a general pattern of remaining at depth, sometimes near the bottom, during the day and rising near the surface during the night in what is believed to be a foraging strategy. Oceanographic features such as frontal boundaries that tend to concentrate forage species (especially cephalopods) apparently have a significant influence on adult swordfish distributions in the North Pacific. Swordfish are relatively abundant near boundary zones where sharp gradients of temperature and salinity exist (Palko et al. 1981). Figure 15 below shows the increasing swordfish catch from 1972 to 2013. Unlike previous figures, swordfish catch is broken down by fleet as most fleets use similar longline gear. Until the mid-1990s, distant water fishing Asian fleets like those from Japan, Korea and Chinese Taipei caught the majority of swordfish. Targeted fleets from Australia and New Zealand then began to compete. In 2004 the Spanish longline fleet entered the market adding to the upswing in swordfish catch (Williams and Terawasi 2014). The U.S. longline fleets catch swordfish primarly in the North Pacific, which is not included in the figure.

Figure 15: South Pacific longline swordfish catch (mt) by fleet 1972-2013



Source: Williams and Terawasi 2014.

3.5.5 **Yellowfin Tuna (*Thunnus albacares*)**

Several studies on the taxonomy, biology, population dynamics, and exploitation of yellowfin tuna exist, including comprehensive reviews by Collette and Nauen (1983) and Suzuki (1994).

This is a tropical tuna characterized by a rapid growth rate and fast development to maturity. Estimates of length at maturity for central and western Pacific yellowfin tuna vary widely with some studies supporting an advanced maturity schedule for yellowfin tuna in coastal or archipelagic waters (Cole 1980). However, most estimates suggest that the majority of yellowfin tuna reach maturity between two and three years of age on the basis of length-age estimates for the species. Longevity for the species may not be explicitly defined, but a maximum age of six to seven years is commonly used in stock assessment. Itano (2000) notes from a large data set from the western tropical Pacific that 50% of yellowfin tuna sampled from purse seine and longline gear at 105 centimeters were histologically classified as mature and predicts a length at 50% maturity of 104.6 centimeters. Under appropriate conditions, yellowfin tuna exhibit high spawning frequency and fecundity (Cole 1980). Spawning occurs in broad areas of the Pacific. Spawning fish require surface salinity and temperature that remain above 24° C (Itano 2000). This means that spawning can occur throughout the year in tropical waters and seasonally at higher latitudes in areas such as Hawaii (Suzuki 1994).Yellowfin tuna are trans-Pacific in distribution, occupying the surface waters of all warm oceans, and form the basis of large surface and sub-surface fisheries. The adult distribution in the Pacific lies roughly within latitudes 40° N to 40° S as indicated by catch records of the Japanese purse seine and longline fishery (Suzuki et al. 1978). Blackburn (1965) suggests the range of yellowfin tuna distribution is bounded by water temperatures between 18° C and 31° C with commercial concentrations occurring between 20° C and 30° C. Although the species preferentially occupies the surface mixed layer above the thermocline, archival tagging has revealed dives to depths in excess of 1,000 meters with water temperature of 5.8° C (Dagorn et al. 2006). Yellowfin are apex predators that rely on a wide

diverse food base, but most heavily prey upon small teleost fish and crustaceans. As juveniles they prey mostly on zooplankton (Graham et al. 2007).

Although tag and recapture programs have documented that yellowfin tuna are clearly capable of large-scale movements, most recaptures occur within a short distance of release. Sibert and Hampton (2003) applied an advection-diffusion model to yellowfin tuna tagging data and determined a median lifetime displacement of 375 miles. Adult yellowfin tuna aggregate in regions of elevated productivity, high zooplankton density (e.g., seamounts), and regions of upwelling and convergence. This association has presumably evolved to capitalize on the elevated forage available (Cole 1980; Suzuki 1994). Yellowfin tuna are also known to aggregate around drifting flotsam, anchored buoys, and large marine animals (Hampton and Bailey 1993). A 2013 study (Weng et al.) observed juvenile yellowfin behavior around a subsurface FAD. They found that yellowfin tuna displayed vertical migrations that included staying at depth during the day and swimming to shallower water at night. Their initial conclusions suggested that variations in these migration patterns may be based on a combination of weather, moon phase, prey movement, and predator avoidance. Major fisheries for yellowfin tuna exploit aggregation effects either by utilizing artificial FADs or by targeting areas with vulnerable concentrations of tuna.

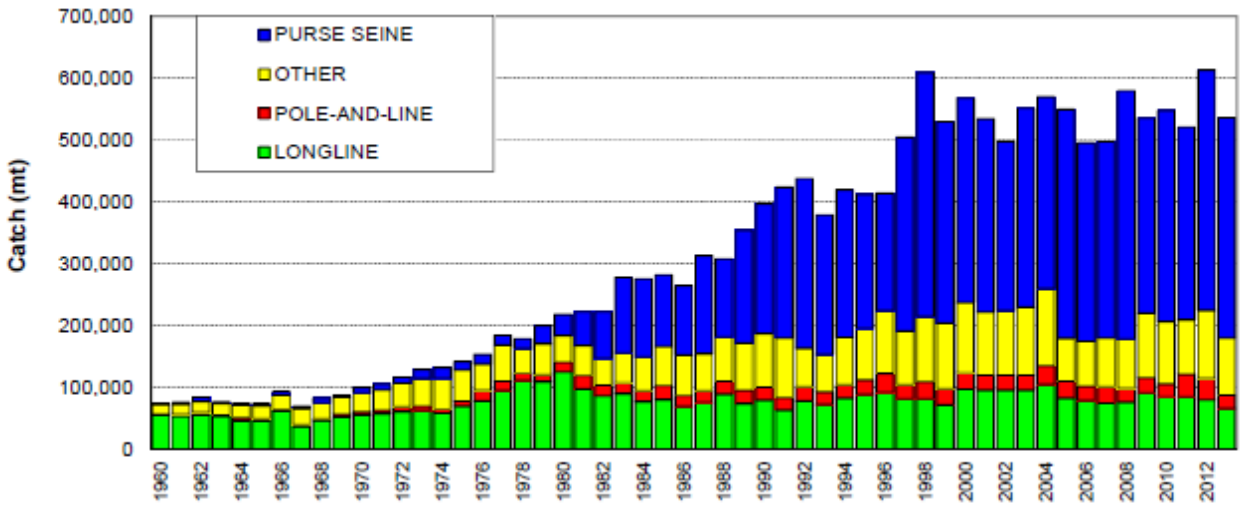
A recent study of the relative impacts of associated and unassociated purse seine sets on yellowfin tuna indicates that unassociated sets yield slightly better stock status, in terms of higher spawning biomass and lower fishing mortality, than associated sets (Hampton and Pilling 2014).

Some genetic analyses suggest that there may be several semi-independent yellowfin tuna stocks in the Pacific Ocean including possible eastern and western stocks, which may diverge around 150° EW (Grewe and Hampton 1998; Itano 2000). Ely et al. (2005) concluded that the genetic drift for yellowfin tuna should be slower than for other tuna species. Morphometric studies of yellowfin tuna also support the hypothesis that populations from the eastern and western Pacific derive from relatively distinct sub-stocks in the Pacific. Other analyses have failed to distinguish the presence of geographically distinct populations (Appleyard et al. 2001). Tagging studies have shown individual animals are capable of large east west movements that would suggest considerable pan-Pacific mixing of the stock.

Purse seining and longlining are the main gear employed in catching yellowfin tuna. Small yellowfin tuna may be caught on the surface by purse seine vessels, while larger fish are typically caught deeper using longline gear (Gillett and Langley 2007). In the western Pacific, the fishery is diverse, occurring in the waters of a number of island nations and on the high seas and carried out by both small domestic fleets and distant water fleets from developed nations.

In 2013, the estimated total yellowfin catch in the WCPO was 535,656 mt, lower than the record catch of 2012. The purse seine fishery was responsible for the bulk of this catch (Williams and Terawasi 2014). Figure 16 below shows the catch of yellowfin tuna in the Convention Area from 1960-2013 by gear type.

Figure 16: Convention Area yellowfin tuna catch (mt) by gear type 1960-2013



Source: Williams and Terawasi 2014.

3.6 *Non Target Species*

As depicted in Table 12 below, based on observer data, the U.S. purse seine fleet operating in the WCPO catches a small amount of various non-target fish species, some of which is retained.

Table 12: Observed Estimates of Catch and Rate of Discards of "Other" Fish Species in 2010 by the U.S. WCPO Purse Seine Fleet.

	Catch (MT)	% Discarded
Black Marlin	52.51	44
Blue Marlin	89.12	58
Marlins - Sailfishes-Spearfishes (UnID)	<.005	100
Sailfish	4.15	25
Shortbilled Spearfish	0.25	72
Striped Marlin	18.12	67
Swordfish	0.49	10
Bigeye Thresher	<.005	100
Blacktip Shark	0.21	99
Blue Shark	0.3	100
Bull Shark	0.06	100
Giant Manta	4.73	99
Manta Rays (UnID)	11.43	100
Mobula (aka Devil Ray)	3.07	99
Oceanic Whitetip Shark	1.68	97
Pelagic Stingray	0.12	98

Rays, Skates and Mantas	0.02	100
Silky Shark	85.15	99
Thresher Sharks	<.005	100
Albacore	0.88	1
Bullet Tuna	0.59	74
Frigate and Bullet Tunas	2.5	58
Frigate Tuna	1.73	74
Kawakawa	1.29	93
Mackerel (UnID)	0.01	100
Wahoo	12.5	38
Amberjack (Longfin Yellowtail)	0.01	0
Amberjack/Giant Yellowtail	62.27	77
Amberjacks	2.72	100
Barracudas	1.07	55
Batfishes	0.3	24
Bigeye Scad	94.72	1
Bigeye Trevally	3.2	40
Black Triggerfish	1.55	96
Brilliant Pomfret	6.35	2
Crestfish/Unicornfish	<.005	100
Drift Fish	<.005	100
Drummer (Blue Chub)	9.5	68
Filfish (Scribbled Leatherjacket)	<.005	100
Filefish (Unicorn Leatherjacket)	<.005	100
Filefishes	0.27	4
Golden Trevally	0.89	0
Great Barracuda	1.63	28
Greater Amberjack	10.6	100
Longfin Batfish	0.06	2
Mackerel Scad/Saba	146.01	97
Mahi Mahi/Dolphinfish/Dorado	44.66	73
Ocean Sunfish	0.98	17
Ocean Triggerfish (Spotted)	23.41	95
Oceanic Triggerfish (UnID)	106.37	95
Opah	0.02	100
Pelagic Puffer	<.005	100

Pilot Fish	<.005	100
Pomfrets and Ocean Breams	2.38	58
Rainbow Runner	510.71	94
Ray's Bream/Atlantic Pomfret	0.04	100
Sargent Major	<.005	100
Saury (Sanma)	0.01	20
Sickle Pomfret	0.01	0
Slender Sunfish	0.39	96
Snake Mackerel	0	100
Spanish Mackerel (Narrow-Barred)	0.04	80
Squids	0.02	75
Trevallies (Unidentified - Jacks)	1.74	58
Triple-Tail	0.25	5
Unspecified	19.21	85
Total	1342.3	

Source: SPC 2012b.

Table 13 and Table 14 show the most common landings of non-target species by the deep and shallow-set Hawaii-based longline fisheries and Table 15 shows the most common non-target species landings of the American Samoa longline fishery

Table 13: Hawaii-based deep-set longline fishery landings and discards of non-target species

Species	Catch (mt)	% Individuals Discarded
Blue Marlin	285.76	0.6
Spearfish	160.57	0.5
Striped Marlin	270.34	0.5
Other Marlin	9.53	2.4
Swordfish	256.73	7.4
Mahimahi	403.24	0.9
Moonfish	713.95	0.3
Oilfish	243.58	1.1
Pomfret	309.35	0.5
Wahoo	166.01	0.3
Blue Shark	68.04*	99.1
Mako Shark		71.6
Thresher Shark		97.9
Other Sharks	-	98.1

Total	2887.1	

Source: WPRFMC 2014. *Shark catch is compiled of all shark species identified as Pelagic Management Unit Species Sharks (PMUS); this includes the 3 species and others. Catch of non-PMUS sharks was not compiled.

Table 14: Hawaii-based shallow-set longline fishery landings and discards of non-target species

Species	Catch (mt)	% Individuals Discarded
Blue Marlin	11.79	1
Spearfish	2.27	8.5
Striped Marlin	11.34	7
Other Marlin	0	50
Swordfish	1.14	8.8
Mahimahi	20.87	4.9
Moonfish	7.71	19.4
Oilfish	10.89	12.6
Pomfret	2.27	25.6
Wahoo	0.45	7.5
Blue Shark	11.79*	99.8
Mako Shark		81.4
Thresher Shark		94.9
Other Sharks		94.7
Total	80.52	

Source: WPRFMC 2014. *Shark catch is compiled of all shark species identified as PMUS; this includes the 3 species and others. Catch of non-PMUS sharks was not compiled.

Table 15: American Samoa based longline fishery landings and discards of non-target species

Species	Catch (mt)	% Individuals Discarded
Mahimahi	10.27	27
Black Marlin	2.09	7
Blue Marlin	36.5	67
Striped Marlin	7.4	44
Wahoo	85.21	22
Sharks (all species)	3.24	98
Swordfish	14.14	22
Sailfish	1.51	87
Spearfish	1.29	94
Moonfish	3.41	75
Oilfish	0.21	100
Pomfret	0.44	89

Source: WPRFMC 2014.

3.7 *Biological Environment*

This section describes the other primary biological resources in the Convention Area as well as ecological interactions between the species.

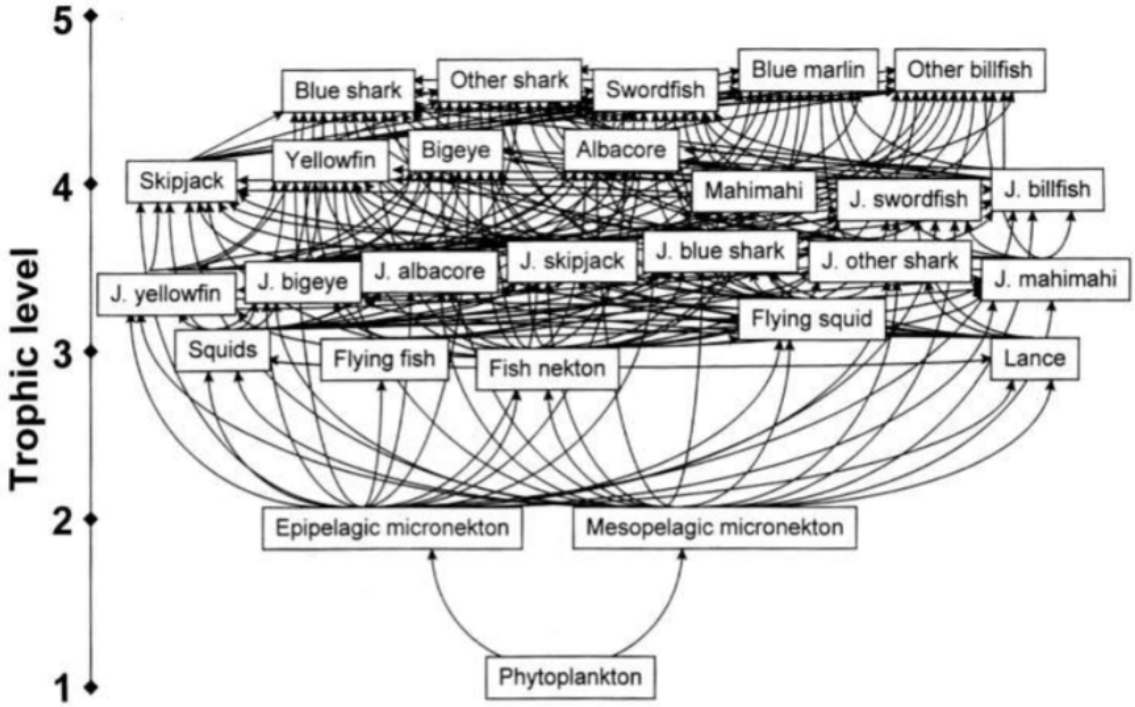
3.7.1 **Trophic Levels**

The following description of a marine fisheries food web is taken primarily from Begon et al. 2006, and Nybakken 1997. Primary producers such as diatoms, dinoflagellates, coccolithophores, and cyanobacteria, are organisms that utilize solar energy to convert carbon dioxide into oxygen. Primary producers are considered the first trophic (or eating) level. The next trophic level includes the zooplankton; planktonic animals such as copepods and larval stages of fish. These microorganisms drift through the water column grazing on phytoplankton (plant-like plankton) and are referred to as "grazers." Copepods are the most abundant zooplankton and make up most of the animal biomass in the ocean. The third trophic level is made up of the molluscan bivalves, amphipods, and larval forms of fish and crustaceans. Small bait fish make up the next trophic level. These include small fish such as sardines which in turn are eaten by big fish, the next trophic level. This level is made up of predators, species that tend to migrate from coastal to deep ocean waters. They are also prey to the apex predators, species at the top-most trophic levels. Species at this trophic level include tunas, billfish, and sharks. Dominant predators as well as apex predators often feed opportunistically, eating anything they encounter. Digested or dead organic matter drifts towards the ocean bottom where both suspended decomposers and bottom feeders utilize the dead matter's energy completing the food web cycle. Both biotic and abiotic factors interact with each other to create this cycle. Organisms at the top of the food web tend to be larger and less abundant. This is mainly due to the amount of energy it takes to survive at the top of a food web. Marine food webs are highly connected because of the openness of marine ecosystems, general lack of specialists, potential for long life-spans, and significant size changes across the life histories of many marine species (Link 2002). Few fully charted examples of open water marine food webs exist. Those that do demonstrate limitations such as low species diversity, high species aggregation, limited spatiotemporal studies, and low chances of detecting important factors such as species richness, interactions or links (Link 2002). Figure 17 shows the interactions between the various trophic levels of the central Pacific food web.

Larval tuna begin at the bottom of the food chain and make their way up. Although thousands of eggs are released by adult tunas only a few make it to the top trophic level. During spawning, bigeye tunas' buoyant eggs are released and float at the surface where they become part of the zooplankton and food for the many organisms and small fish feeding in the equatorial surface waters. Larval bigeye tuna begin feeding on the same zooplankton that they are a part of. Fully formed juveniles begin eating small fish, crustaceans, and squid. These juveniles also begin to move north and south of equatorial waters and are often preyed upon by larger tunas and billfish. Larval and juvenile bigeye tuna are also eaten by other fish, seabirds, porpoises, and other animals. After about one year, the adult bigeye tuna is an opportunistic predator with a highly varied diet of fish, crustaceans, and squid. It is also now prey to larger tunas and billfish. The main predators of bigeye tuna are large billfish and toothed whales.

Trophic level ascension through the food chain for yellowfin tuna is practically the same as for bigeye tuna. Yellowfin tuna feed opportunistically at all life stages. Larval and juvenile yellowfin tuna are eaten by other fish, seabirds, porpoises, and other animals such as marine mammals and sharks that eat adult tunas. Large yellowfin tunas prey on crustaceans, large squid, and fish species. There is a high degree of cannibalism on juvenile yellowfin tunas among large yellowfin tuna in certain parts of the oceans.

Figure 17: Trophic diagram of the central Pacific Ocean



Source: MRAG Americas (2002), adapted from Kitchell et al. 1999.

Understanding an ecosystem depends on the identification of its food web and the exchanges between the different trophic levels in the food chain. Food webs show the dynamics of biomass production, sinks, and partitioning. Even minor changes in abiotic factors can cause far reaching changes in the spatial distribution of primary and secondary pelagic production (Richardson et al. 2004). For example, increases in sea surface temperatures may lead to increases or decreases in phytoplankton abundance depending on the *in situ* water temperature (Richardson et al. 2004). Tuna removal by commercial fisheries or other changes in biotic balances could have lasting effects lower down the food chain. Models done by Hinke et al. (2004), and observations by Halpern et al. (2006) demonstrate that by removing top predators, mid and low trophic level species may expand due to the elimination of competition and predation, and that top down food web control may be more important to ecosystem balance than previously thought. As apex predators, albacore, bigeye tuna, skipjack tuna, swordfish, and yellowfin tuna are in the top trophic level with distinct energy pathways supporting each species (Hinke et al. 2004). They are opportunistic feeders, a quality that complicates trophic impact analysis (Cox et al. 2002).

Distinct energy pathways support different tuna species (Hinke et al. 2004). Based on this theory models show that removing top predators such as tunas lower the biomass at the upper trophic levels and that indirectly this increases the biomass of intermediate and lower trophic level animals (Hinke et al. 2004). For example, bigeye and yellowfin tuna are opportunistic feeders and may pose a problem when analyzing significant trophic impacts (Cox et al. 2002). Trophic status studies show that biomass of both bigeye and yellowfin stocks have declined to MSY-associated levels. Ecosystem impacts from these declines are unknown, yet fishing any species in an ecosystem at mortality rates yielding single-species MSY may lead to the erosion of trophic structure and have negative effects on recruitment (Sibert et al. 2006). Disturbing the balance of any ecosystem may lead to potential shifts in the ecosystem. For example, an increase in water temperature can cause shifts in vertical and horizontal distributions, which in turn depend greatly on trophic and hydrologic conditions (Perry et al. 2005).

The effects of fisheries on entire food webs remain uncertain.. When there is an overlap in the primary forage trophic level, as when multiple fisheries act on top predator tunas, there are indirect effects seen within their own forage groups. Hinke et al. (2004) concluded that the primary food webs for individual fisheries were relatively simple. Precise ecosystem analysis, however, is difficult because the interactions among a broad group of species are not always apparent or recognized. Each stock has a unique recruitment history so the variability in biomass over time and among stocks can not necessarily all be attributed to fishing (Sibert et al. 2006). Cox et al. (2002) also found that declines in top predators could result in an increase in smaller tunas that serve as prey to larger tunas. Predation as a component of natural mortality is still unclear, as are the effects of fishing mortality on these predation rates and abundance.

Understanding the relative importance of top-down (consumer-driven) versus bottom-up (resource-driven) control of food webs and whether ecosystem trophic dynamics are driven more by predation or primary production is another focus of ecological studies (Richardson et al. 2004; Ware and Thomson 2005; Halpern et al. 2006). The form and strength of the linkages between trophic levels is important (Richardson et al. 2004). Fishing alters community structure at all trophic levels as well as the links to other community members. Although overfished stocks may recover, communities that have changed may take a long time or may never recover (Katz et al. 2003). Halpern et al. (2006) concluded that if anthropogenic sources continue as they are, removing top predators may cause large ecosystems to become controlled by bottom-up rather than top-down factors.

Hinke et al. (2004) found that purse seine gear has been more strongly felt at the higher trophic levels than at the lower ones, yet the purse seine fleet may also affect the lower trophic levels. This study revealed that the aggregate effect of purse seine fishing in the central North Pacific Ocean (CNP) showed a shift in the distribution of biomass from upper level predators to their prey. Their models of the effects of purse seining in the CNP show primarily indirect effects on lower trophic levels. Similar changes in the overall structure of the food webs can be seen from pelagic tuna fisheries in the eastern tropical Pacific Ocean by the purse seine fleets as compared to the CNP findings analyzed by Hinke et al. (2004).

Hinke et al. (2004) also found that the aggregate effect of longline fishing in the CNP showed a shift in the distribution of biomass from upper level predators to their prey. Their models of the

effects of longlining in the CNP indicated that the effects of longlining were direct and strongest at the upper trophic levels. Similar changes in the overall structure of the food webs can be seen from pelagic tuna fisheries in the eastern tropical Pacific Ocean as compared to the CNP findings analyzed by Hinke et al. (2004).

In 2010, the OFP at the SPC reported some of its findings on an ongoing study of the WCPO tuna ecosystem that attempts to model and understand species relationships, with an end goal of assessing future environmental and fishery impacts on tuna stock health. In the analysis of stomach contents, yellowfin, bigeye and skipjack tuna were split into three size categories (baby, small and large) to account for growth-related diet shifts as well as whether they filled a predominantly predator or prey role. All three tunas were found to primarily eat smaller fish, followed by mollusks and crustaceans (Allain 2010).

3.8 *Protected Resources*

The following sections include information regarding threatened and endangered species, Essential Fish Habitat (EFH) established pursuant to the MSA, National Wildlife Refuges (NWRs) and Monuments. Table 16 includes all species listed under the U.S. Endangered Species Act (ESA) in the Convention Area. NMFS has jurisdiction over all the species listed except for the Chatham petrel (*Pterodroma axillaris*), dugong (*Dugong dugon),* Fiji petrel (*Pseudobulweria macgillivrayi*), Hawaiian dark-rumped petrel (*Pterodroma phaeopygia sandwichensis)*, Magenta petrel (*Pterodroma magentae*), Newell's shearwater (*Puffinus auricularis newelli*), and short-tailed albatross (*Phoebastria albatrus*). The U.S. Fish and Wildlife Service (USFWS) has jurisdiction over these seven species.

Table 16: Listing status of species in the WCPO listed as endangered or threatened under the U.S. Endangered Species Act

Scientific Name	Common Name	ESA
Acropora globiceps	Coral (no common name)	Threatened
Acropora jacquelineae	Coral (no common name)	Threatened
Acropora lokani	Coral (no common name)	Threatened
Acropora pharaonis	Coral (no common name)	Threatened
Acropora retusa	Coral (no common name)	Threatened
Acropora rudis	Coral (no common name)	Threatened
Acropora speciosa	Coral (no common name)	Threatened
Acropora tenella	Coral (no common name)	Threatened
Anacropora spinosa	Coral (no common name)	Threatened
Balaenoptera borealis	Sei whale	Endangered
Balaenoptera musculus	Blue whale	Endangered
Balaenoptera physalus	Fin whale	Endangered
Caretta caretta	Loggerhead turtle (North Pacific and South Pacific distinct population segments (DPS))	Threatened
Chelonia mydas	Green turtle	Threatened

Dermochelys coriacea	Leatherback turtle	Endangered
Dugong dugon	Dugong	Endangered
Eretmochelys imbricata	Hawksbill turtle	Endangered
Eubalaena australis	Southern right whale	Endangered
Eubalaena japonica	North Pacific right whale	Endangered
Euphyllia paradivisa	Coral (no common name)	Threatened
Isopora crateriformis	Coral (no common name)	Threatened
Lepidochelys olivacea	Olive Ridley turtle	Threatened
Megaptera novaeangliae	Humpback whale	Endangered
Monachus schauinslandi	Hawaiian monk seal	Endangered
Montipora australiensis	Coral (no common name)	Threatened
Pavona diffluens	Coral (no common name)	Threatened
Phoebastria albatrus	Short-tailed albatross	Endangered
Physeter macrocephalus	Sperm whale	Endangered
Porites napopora	Coral (no common name)	Threatened
Pseudobulweria macgillivrayi	Fiji Petrel	Endangered
Pseudorca crassidens	Main Hawaiian Islands insular false killer whale	Endangered
Pterodroma axillaris	Chatham Petrel	Endangered
Pterodroma magentae	Magenta Petrel	Endangered
Pterodroma phaeopygia sandwichensis	Hawaiian Dark-rumped Petrel	Endangered
Puffinus auricularis newelli	Newell's shearwater	Threatened
Seriatopora aculeata	Coral (no common name)	Threatened
Sphyrna lewini	Scalloped Hammerhead Shark[19]	Threatened

Source: http://www.nmfs.noaa.gov/pr/species/esa/listed.htm

The U.S. purse seine fishery, as described in Section 3.2.1 of this PEA, does not involve contact with the seafloor or benthic habitats, and operations take place far from coastlines, so the fishery does not spatially overlap with the listed coral species. By memorandum dated October 6, 2014, NMFS determined that the management and operation of Pacific pelagic fisheries under the FEP and implementing regulations, which include the American Samoa-based and Hawaii-based longline fisheries, would have no effect on the ESA-listed reef corals that are believe to occur in the U.S. EEZ, due to spatial separation between fishery operations under the FEP and the corals.

The Final Biological Opinion and Incidental Take Statement for the U.S. purse seine fishery for effects to ESA-listed sea turtles and marine mammals was issued on November 1, 2006, concluding formal Section 7 ESA consultation for species under the jurisdiction of NMFS. In

[19] Effective September 2, 2014, NMFS listed two distinct DPS of the scalloped hammerhead shark as threatened and two DPS as endangered (see 79 FR 38214). The U.S. WCPO purse seine fishery, the American Samoa longline fishery, and the Hawaii-based deep-set fishery operate within the boundaries of the Indo-West Pacific DPS; the Hawaii-based shallow-set fishery and the Hawaii-based deep-set longline fishery operate within the boundaries of the Eastern Pacific DPS.

addition to the coral species mentioned above, two species under the jurisdiction of NMFS have been ESA-listed since that time: the main Hawaiian Islands insular false killer whale and the Indo-West Pacific DPS of the scalloped hammerhead shark. The range of the main Hawaiian Islands insular false killer whale does not overlap with the area in which the U.S. WCPO purse seine fleet operates.[20] The area of operation of the U.S. purse seine fishery in the WCPO overlaps with the range of the Indo-West DPS of the scalloped hammerhead shark. In a memorandum dated October 21, 2014, NMFS analyzed the effects of the U.S. purse seine fishery on this DPS of the scalloped hammerhead shark, pending completion of formal ESA Section 7 consultation during the 2015 calendar year. Based on the best available information, NMFS determined that risk of the continued operation of the U.S. WCPO purse seine fishery on the Indo-West Pacific DPS of the scalloped hammerhead shark during the calendar year 2015 is negligible and not likely to jeopardize the continued existence of the DPS.

By letter dated January 28, 2009, the USFWS concurred with NMFS' determination that a proposed regulation that would not alter U.S. purse fishing practices or fishing effort would not be likely to adversely affect ESA-listed species under the jurisdiction of USFWS, which at the time included the dugong, Newell's shearwater, and short-tailed albatross. This determination was based on the fact that there was minimal spatial overlap between the U.S. purse seine fishery and the range of the dugong, no spatial overlap between the U.S. purse seine fishery and range of the short-tailed albatross, and no recorded interactions between the U.S. purse seine fleet and seabirds or dugongs, based on observer data from August 1994 to January 2007. Four species under the jurisdiction of USFWS (the Hawaiian dark-rumped petrel, Chatham petrel, Fiji petrel, and magenta petrel) have been ESA-listed since that time. Based on observer data available to NMFS, the U.S. WCPO purse seine fleet has not been reported to interact with seabirds.

Several biological opinions for the Hawaii-based and American Samoa-based longline fisheries are relevant for ESA-listed species under the jurisdiction of NMFS. The most recent biological opinion for the continued operation of the Hawaii-based deep-set longline fishery was completed on September 19, 2014. The most recent biological opinion for the continued operation of the Hawaii-based shallow-set longline fishery was completed on January 30, 2012, with technical corrections made on May 22, 2013 and May 29, 2013. The most recent biological opinion for the American Samoa longline fishery – for an amendment modification to the Pelagics FEP, including amendment modifications for the American Samoa longline fishery – was completed September 16, 2010. For ESA-listed species under the jurisdiction of USFWS, the most recent biological opinion for the Hawaii-based longline fisheries was completed on January 6, 2012.

On May 8, 2015, NMFS reinitated consultation for the American Samoa longline fishery based on the fishery's exceedance of the authorized incidental take of one leatherback and one olive ridley turtle over a three-year period and NMFS' recent listing of the Indo-West Pacific DPS of the scalloped hammerhead shark. By memorandum dated May 8, 2015, NMFS determined that the conduct of the American Samoa pelagic longline fishery during the period of consultation would not violate ESA Section 7(a)(2) and 7(d).

[20] The range of the main Hawaiian Islands insular false killer whale includes the waters around the main Hawaiian islands from Ni'ihau to Hawai'i, and offshore as far as 140 kilometers. The U.S. WCPO purse seine fleet generally operates much further south, between 10° N and 10° S latitude.

The coral species are the only newly-listed species that were not considered in the most recent biological opinion for the Hawaii-based deep-set fishery. The coral species and the following two species under NMFS' jurisdiction have been ESA-listed since completion of the most recent biological opinion for the Hawaii-based shallow-set fishery: the main Hawaiian Islands insular false killer whale and the Eastern Pacific DPS of the scalloped hammerhead shark. By letter dated March 2, 2015, NMFS concluded informal consultation on the Eastern Pacific DPS of the scalloped hammerhead shark and the main Hawaiian Islands insular false killer whale, concluding that the continued authorization of the Hawaii shallow-set longline fishery under the Pelagics FEP was not likely to adversely affect those two newly-listed species.

ESA-listed species under the jurisdiction of USFWS not included in these biological opinions that could be affected by the longline fisheries were subject to separate informal consultations under Section 7 of the ESA. NMFS determined that the American Samoa longline fishery would not affect the Chatham Petrel, Fiji Petrel, or Magenta Petrel and would not be likely to adversely affect the Newell's Shearwater – these are the four ESA-listed seabirds potentially in the area in which the American Samoa longline fishery operates. NMFS determined that the Hawaii longline fisheries will not affect the dugong, Newell's Shearwater, or Hawaiian Dark-rumped Petrel. The seabirds most likely to be impacted by longline fisheries are albatrosses and species of petrels other than the *Pterodroma* species, and the USFWS has specifically stated that it does not believe that longline fishing is a significant threat to the Chatham Petrel, Fiji Petrel, or Magenta Petrel (see 74 FR 46914).

3.8.1 **Marine Mammals**

All marine mammals receive protection under the Marine Mammal Protection Act (MMPA; 16 USC 1361, *et seq*.). The marine mammals found in the WCPO but not listed under the ESA as threatened or endangered (i.e., not included in Table 16) are listed in Table 17 below.

Table 17: Non-ESA listed marine mammals that occur in the WCPO

Species name	Common name
Balaenoptera acutorostrata	Minke whale
Balaenoptera bonaerensis	Antarctic minke whale
Balaenoptera edeni	Bryde's whale
Berardius arnuxii	Arnoux's beaked whale
Caperea marginata	Pygme right whale
Delphinus delphis	Short-beaked common dolphin
Eschrichtius robustus	Gray whale
Feresa attenuata	Pygme killer whale
Globicephala macrorhynchus	Short-finned pilot whale
Globicephala melas	Long-finned pilot whale
Grampus griseus	Risso's dolphin
Hyperoodon planifrons	Southern bottlenose whale
Indopacetus pacificus	Longman's beaked whale

Kogia breviceps	Pygme sperm whale
Kogia sima	Dwarf sperm whale
Lagenodelphis hosei	Fraser's dolphin
Lagenorhynchus cruciger	Hourglass dolphin
Lagenorhynchus obliquidens	Pacific white sided dolphin
Lagenorhynchus obscurus	Dusky dolphin
Lissodelphis peronii	Southern right whale dolphin
Mesoplodon bowdoini	Andrew's beaked whale
Mesoplodon ginkgodens	Ginkgo-toothed whale
Mesoplodon grayi	Gray's beaked whale
Mesoplodon hectori	Hector's beaked whale
Mesoplodon layardii	Strap-toothed whale
Mesoplodon stejnegeri	Stejneger's beaked whale
Mesoplodon traversii	Spade-toothed whale
Orcinus orca	Killer whale
Peponocephala electra	Melon headed whale
Phocoena dioptrica	Spectacled porpoise
Phocoena phocoena	Harbor porpoise
Phocoenoides dalli	Dall's porpoise
Pseudorca crassidens	False killer whale
Stenella attenuata	Pantropical spotted dolphin
Stenella coeruleoalba	Striped dolphin
Stenella longirostris	Spinner dolphin
Steno bredanensis	Rough toothed dolphin
Tursiops truncatus	Bottlenose dolphin
Ziphius cavirostris	Cuvier's beaked whale
Mesoplodon densirostris	Blainville's Beaked Whale
Mirounga angustirostris	Northern Elephant Seal
Callorhinus ursinus	Northern Fur Seal

Source: [http://www.wpcouncil.org/species-protection/marine-mammals; NOAA, http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans, 2014.]

3.8.1.1 Marine Mammal Interactions

All marine mammals are protected under the MMPA. Pursuant to the MMPA, NMFS has promulgated specific regulations that govern the incidental take of marine mammals during fishing operations (50 CFR § 229). The regulations designate three categories of fisheries, based on relative frequency of incidental serious injuries and mortalities of marine mammals in each fishery:

- Category I designates fisheries with frequent serious injuries and mortalities incidental to commercial fishing;

- Category II designates fisheries with occasional serious injuries and mortalities;
- Category III designates fisheries with a remote likelihood or no known serious injuries or mortalities.

The Hawaii-based deep-set longline fishery is classified as a Category I fishery and the shallow-set longline fishery is classified as a Category II fishery. The American Samoa longline fishery is classified as a Category II fishery. The WCPO purse seine fishery is classified as a Category II fishery (79 FR 77919, December 29, 2014).

When marine mammals interact with fisheries there may be both direct and indirect impacts. Direct impacts result when marine mammals get hooked, entangled, or hurt by human activities. Direct impacts may result from depredation (a marine mammal's removing or damaging fish hooked on fishing gear), removal of bait from fishing gear, or unintentional interactions with gear. Indirect impacts either take place either later in time or further away from the physical location where direct impacts occur. An indirect impact to consider between fisheries and marine mammals is competition for prey (SPC 2001) due to increasing scarcity of food resources driven by overfishing (Tudela 2004).

3.8.2 **Essential Fish Habitat**

The EFH provisions (50 CFR Part 600 Subpart J) of the MSA are intended to maintain sustainable fisheries. NMFS and the Fishery Management Councils must identify and describe EFH and Habitat Areas of Particular Concern (HAPC) for each managed species using the best available scientific data and must ensure that fishing activities being conducted in such areas do not have adverse effects to the extent practicable. This process consists of identifying specific areas and the habitat features within them that provide essential functions to a particular species for each of its life stages. Both the EFH and the HAPC are documented in the FEPs established under the MSA.[21]

EFH and HAPC have been designated in the WCPO for pelagic, bottomfish and seamount groundfish, precious corals, crustaceans, and coral reef species. Table 18 lists the EFH and HAPC for species managed under the various western Pacific FEPs.

[21] The FEPs being the FEP for the American Samoa Archipelago, the FEP for the Mariana Archipelago; the FEP for the Pacific Remote Island Areas; the FEP for the Hawaii Archipelago; and the FEP for Pacific Pelagic Fisheries of the Western Pacific Region.

Table 18: EFH and HAPC for species managed under the pelagics, crustaceans, bottomfish and seamount groundfish, precious corals, crustaceans, and coral reef ecosystems, western Pacific FMPs[1]

Species Group	EFH (juveniles and adults)	EFH (eggs and larvae)	HAPC
Pelagics	Water column down to 1,000 meters	Water column down to 200 meters	Water column down to 1,000 meters that lies above seamounts and banks
Bottomfish	Water column and bottom habitat down to 400 meters	Water column down to 400 meters	All escarpments and slopes between 40-280 meters, and three known areas of juvenile opakapaka habitat
Seamount Groundfish	(adults only): water column and bottom from 80 to 600 meters, bounded by 29°-35°N and 171°E-179°W	(including juveniles): epipelagic zone (0-200 meters) bounded by 29°-35°N and 171°E-179°W	Not identified
Precious Corals	Keahole, Makapuu, Kaena, Wespac, Brooks, and 180 Fathom gold/red coral beds, and Milolii, S. Kauai and Auau Channel black coral beds	Not applicable	Makapuu, Wespac, and Brooks Bank beds, and the Auau Channel
Crustaceans	Lobsters: Bottom habitat from shoreline to a depth of 100 meters Deepwater shrimp: The outer reef slopes at depths between 300-700 meters	Water column down to 150 meters Water column and associated outer reef slopes between 550 and 700 meters	All bank with summits less than 30 meters No HAPC designated for deepwater shrimp
Coral Reef Ecosystems	Water column and benthic substrate to a depth of 100 meters	Water column and benthic substrate to a depth of 100 meters	All Marine Protected Areas identified in FMP, all PRIAs,[2] many specific areas of coral reef habitat

Source: FEP for the American Samoa Archipelago, Table 20 (WPRFMC 2009b).
[1] All areas bounded by the shoreline and the outward boundary of the U.S. EEZ, unless otherwise indicated.
[2] Pacific Remote Island Areas.

3.8.3 National Wildlife Refuges (NWRs) and Monuments

Pursuant to the National Wildlife System Administration Act of 1966 (NWSAA; 16 U.S.C. § 668dd, et seq.), USFWS carries out the mission of NWRs, which is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." National Monuments are designated by the President using the authority of the Antiquities Act of 1906 (16 U.S.C. 431). This act allows the president to protect areas of "historic or scientific significance." There are 10 NWRs and four National Monuments in the Convention Area: Guam NWR; Baker Island NWR;

Howland Island NWR; Jarvis Island NWR; Johnston Island NWR; Kingman Reef NWR; Palmyra Atoll NWR; Rose Atoll NWR; Hawaiian Islands NWR; Midway Atoll NWR; Papahanaumokuakea Marine National Monument; the Marianas Trench Marine National Monument; the Pacific Remote Islands Marine National Monument, which includes Wake, Baker, Howland, and Jarvis Islands, Johnston Atoll, Kingman Reef, and Palmyra Atoll; and the Rose Atoll Marine National Monument.

NMFS published a final rule that prohibits commercial fishing in the Pacific Remote Islands and Rose Atoll Monuments, and in the Islands Units of the Marianas Trench Monument; establishes management measures for non-commercial and recreational charter fishing in the Monuments; and prohibits the conduct of commercial fishing outside the Monuments and non-commercial fishing inside the Monuments during the same trip (78 FR 32996; June 3, 2013).

3.8.3.1 Pacific Remote Island Marine National Monument Expansion

In September 2014, President Obama issued Presidential Proclamation 9173 (79 FR 58645, September 29, 2014) that expanded the protected areas around the already protected Wake Island, Jarvis Island, and Johnston Atoll. Protected areas were expanded to the outer limit of the U.S. EEZ. This expansion added 308,316 square nautical miles of protected waters to the Monument which is now the largest marine reserve in the world. In March 2015, NMFS published a final rule to prohibit commercial fishing, while allowing for managed non-commercial fishing, in the expanded portion of the monument (see 80 FR 15693; published March 25, 2015).

Chapter 4 Environmental Consequences: Direct and Indirect Effects

This chapter examines the direct and indirect environmental impacts that would be expected to result from implementation of each of the action alternatives as well as the No-Action Alternative, which are described in Chapter 2. Cumulative impacts are addressed in Chapter 5.[22]

This chapter generally follows the organization of Chapter 3. The discussion of potential impacts to the fisheries is presented first to establish the changes that the affected fisheries could experience from implementation of each of the alternatives. Then Sections 4.4 to 4.9 analyze the environmental impacts the anticipated changes to the fisheries could cause to each of the potentially affected resources in the affected environment. The chapter concludes with a summary that compares the different impacts of the alternatives.

4.1 *The U.S. WCPO Purse Seine Fishery*

The direct and indirect effects to the U.S. WCPO purse seine fishery from implementation of each of the alternatives would fall into two categories: (1) economic; and (2) changes to fishing patterns and practices. General information regarding economic impacts is provided in the discussion below to help compare the alternatives assessed and to determine whether the economic impacts are interrelated with environmental impacts. More specific information regarding economic impacts would be provided for each regulatory action undertaken by NMFS to implement the elements of the proposed action (i.e., an action taken under one of the administrative processes outlined in Section 1.3 of this PEA) through preparation of a Regulatory Impact Review (RIR), prepared under Executive Order 12866. The potential impacts from implementation of each of the alternatives to each of the potentially affected resources are analyzed in Sections 4.4 to 4.9.

4.1.1 **Alternative A: The No-Action Alternative**

Under Alternative A, the No-Action Alternative, the management measures for the U.S. purse seine fleet that would be implemented under the action alternatives would not go into effect, and the fleet would continue to be managed under existing regulatory requirements, including SPTT-related requirements, and any changed or new requirements as the result of a renegotiated Treaty and its associated economic assistance agreement, as described in more detail in Section 3.2 of this document. Thus, under this alternative there would be no direct changes to the fishing patterns and practices of the fleet.

[22] According to the CEQ regulations implementing the Procedural Provisions of NEPA at 40 CFR §1508.7 and §1508.8, direct effects are caused by the action and occur at the same time and place; indirect effects are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable; and cumulative impacts are the impacts on the environment that result from the incremental impact of the Proposed Action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions.

As described in Section 1.4 of this PEA, the purpose of the proposed action is to contribute to the underlying objectives of the Commission's management of tropical tuna stocks in the WCPO, which, as stated in CMM 2014-01, are to reduce or maintain their respective fishing mortality rates at levels no greater than those rates associated with maximum sustainable yield, and as reflected in the Commission's limit reference points for these stocks, are to avoid the spawning stocks becoming smaller than 20 percent of the estimated spawning stock size in the absence of fishing. As stated in Section 3.5 of this PEA, Pacific bigeye tuna is currently subject to overfishing but not overfished, while the stocks of yellowfin tuna and skipjack tuna in the WCPO are neither experiencing overfishing nor overfished. As described in Chapter 3 of this PEA, skipjack tuna accounts for the majority of the fleet's catch, with the proportion of catch of each of the three tropical tuna species being approximately 79 percent skipjack tuna, 17 percent yellowfin tuna, and four percent bigeye tuna for the period 1997-2013. Thus, it is conceivable that under this alternative the indirect effects (or long-term effects) would be that the objectives of the proposed action would be less likely to be reached, which in turn could be expected to adversely affect the catch rates of the U.S. WCPO purse seine fleet to maintain catch levels and the profitability of fishing businesses. However, as discussed in Section 3.5 of this PEA, many other factors affect the stock status of bigeye tuna, yellowfin tuna, and skipjack tuna in the WCPO (such as oceanographic conditions and fishing by non-U.S. fleets). Thus, there could be no indirect effects to the fleet under the No-Action Alternative.

4.1.2 **Alternative B: Least Restrictive Action Alternative**

Under this alternative, the management measures that would affect the U.S. purse seine fleet include a U.S. purse seine fishing effort limit of 3,898 fishing days in the ELAPS, a three month FAD setting prohibition period, and a yellowfin tuna catch limit of 45,363 mt for U.S. purse seine vessels for each calendar year from 2015-2020. These elements for purse seine vessels would apply between the latitudes of 20° N. and 20° S. in the Convention Area, except for territorial seas and archipelagic waters. The potential effects of each of the elements of Alternative B on the fishing patterns and practices of the fleet are described in the following subsections.

4.1.2.1 Fishing Effort Limit

As indicated in Table 2 in Chapter 3 of this EA, from the years 1997 through 2013, the fleet spent an average of approximately 5 percent of its total effort per year in the U.S. EEZ and 18 percent of its total effort per year on the high seas, and the remainder (or 77 percent) in the EEZs of Pacific Island Parties to the SPTT. Given that the fishing effort limit in the ELAPS under this alternative exceeds the average number of days fished in the ELAPS during the years 1997 through 2013 by a considerable amount, it is unlikely that the limit would be reached under this alternative. However, should the limit be reached, the fishery would be closed on the high seas and in the U.S. EEZ for the remainder of the calendar year. Although the length of any such closure cannot be predicted with any degree of certainty, due to the large variation in the number of days fished in the U.S. EEZ and on the high seas from year to year, as shown in Table 2, given the large number of fishing days under this alternative, it is likely any closure would take place toward the end of the year, if at all.

If the limit is reached in any year, vessels in the fleet could continue to fish in the EEZs of Pacific Island Parties to the SPTT, where the fleet expends the majority of its effort. Vessels in the fleet would also have the option to continue to fish in the EPO in the area managed by the Inter-American Tropical Tuna Commission (IATTC).

Under the SPTT, the fleet is likely to have a number of fishing days available in the Pacific Island country EEZs that dominate the western portion of the WCPO. However, oceanographic conditions would determine whether the western fishing grounds are favorable compared with those in the eastern portion of the Convention Area. For 2015, it is evident that El Niño conditions are present and that there is a 60 percent chance they will persist through the northern autumn of 2015 (National Weather Service (NWS) 2015). This suggests that the eastern portion of the Convention Area will be favored fishing grounds in most of 2015. Both the ELAPS and the Kiribati EEZ are situated predominantly in the eastern side of the WCPO, and both these areas would be effectively closed to U.S. purse seine fishing during an ELAPS closure in 2015 and perhaps in 2016-2020 as well (the U.S. fleet might have some fishing days available in the Kiribati EEZ, but the number is likely to be small unless new access arrangements are agreed to, which does not appear likely at present). Thus, although fishing in the Convention Area outside the ELAPS might be relatively attractive in terms of next-best opportunities, it would likely bring substantial additional costs to fishing operations. However, if El Niño conditions weaken in 2015 (as indicated above, there is 60% chance of El Niño persisting through the northern autumn) or are not present in 2016-2020, western fishing grounds (e.g., in the EEZs of the Republic of the Marshall Islands and the Federated States of Micronesia) would likely become more favorable. In that case, large portions of both the ELAPS and the Kiribati EEZ would become less favorable, and the adverse economic impacts of an ELAPS closure would be less severe.

With respect to fishing in the EPO, the EPO tends to be fished relatively little by the fleet, indicating it contains relatively unfavorable fishing grounds (although, as indicated above, it tends to become more favorable during El Niño events) and/or involves prohibitive costs. In order to fish in the EPO, a vessel must be on the IATTC's Regional Vessel Register and categorized as active (50 CFR 300.22(b)), which involves fees of about $14.95 per cubic meter of well space per year (e.g., a vessel with 1,200 m^3 of well space would be subject to annual fees of $17,940).[23] The number of U.S. purse seine vessels in the WCPO fleet that have opted to be categorized as such has recently increased from zero to eleven, probably because of constraints on fishing days in the WCPO and/or uncertainty in future access arrangements under the SPTT. This suggests a possibility of an increasing attractiveness of fishing in the EPO, in spite of the costs associated with doing so.Vessels licensed under the SPTT can each take one fishing trip per year in the area managed by the IATTC, for a period up to 90 days in duration, so long as the total number of trips by all vessels in the fleet does not exceed 32 days per calendar year. In addition, although the IATTC has adopted capacity limits for purse seine vessels operating in the EPO, the United States has a little over 5,000 cubic meters remaining of its allocated capacity (as of March 2015). So, this capacity is available for vessels in the U.S. WCPO purse seine fleet who wish to become active on the IATTC vessel register and fish in the EPO in the area of

[23] As an exception to this rule, an SPTT-licensed vessel is allowed to make one fishing trip in the EPO each year without being categorized as active on the IATTC Regional Vessel Register. The trip must not exceed 90 days in length, and there is an annual limit of 32 such trips for the entire SPTT-licensed fleet (50 CFR 300.22(b)(1)).

competence of the IATTC. Although, as of this writing, no U.S. purse seine vessels have shifted to fishing in the EPO.

Overall, 2015-2020 could be years in which the U.S. EEZ or high seas provides more attractive fishing grounds than usual, and in that case, the fleet could be restricted by the effort limits. Indeed, fishing effort in the ELAPS so far in 2015 has been unusually great. This is likely related to the severely limited number of fishing days available in the Kiribati EEZ, as well as the prevailing El Niño conditions, which as described above tend to make the eastern part of the WCPO more favorable fishing grounds than at other times. Also, as discussed in Chapter 3, the SPTT is being renegotiated, which may result in changes to the current management regime, including changes to the amount of effort allowed in the EEZs of Pacific Island Parties to the SPTT. Should fishing opportunies outside the ELAPS be reduced from current levels, there would be a greater likelihood of the limit being reached.

The effort limit could change the temporal patterns of fishing effort. Since the limit would be a competitive allocation whereby ELAPS fishing days would not be allocated among individual vessels and would be available to the entire fleet until the cap is reached, some vessel operators might have an incentive to fish harder in these two areas earlier in the calendar year than they otherwise would in an attempt to obtain as many fishing days as they can (i.e., “the race to fish”) before the limit is reached. To the extent such a shift does occur, it would affect the seasonal timing of deliveries to canneries. A race to fish could also bring costs if it causes vessel operators to forego vessel maintenance or to fish in weather or ocean conditions that it otherwise would not. This could bring costs in terms of human safety as well as the performance of the vessel and its fishing gear and crew, but the effects are not expected to be substantial, as the fleet does not exerts the majority of its fishing effort in the ELAPS. This race to fish effect could also be expected in the time period between when a closure of the fishery is announced and when the fishery is closed.

In addition, since the fleet generally fishes in areas outside of the ELAPS, it is possible that there could be no overall change in the amount of fishing effort of the fleet in 2015-2020 compared to the No-Action Alternative.

4.1.2.2 FAD Setting Prohibition Period

Under this alternative, there would be a prohibition on setting on FADs and on fish that have aggregated in association with a fishing vessel, in the Convention Area between the latitudes of 20° North and 20° South, for three months of the year for each of the years 2015 through 2020 (for the purposes of this analysis, the three months are not specified, and could be any three months of each calendar year). During the three months in which no fishing on FADs would be allowed, no fishing on or near schools associated with FADs, and no deploying or servicing FADs, would be permitted in the Convention Area in the area between 20° N. and 20° S. latitude.

The specific prohibitions, which include details for enforcement purposes, would be the following:

- No setting of a purse seine around a FAD or within one nautical mile of a FAD;
- No setting of a purse seine in a manner intended to capture fish that have aggregated in association with a FAD or a vessel, such as by setting the purse seine in an area from which a FAD has been moved or removed within the previous eight hours, or setting the purse seine in an area in which a FAD has been inspected or handled within the previous eight hours, or setting the purse seine in an area into which fish were drawn by a vessel from the vicinity of a FAD;
- No deployment of a FAD into the water;
- No repairing, cleaning, maintaining, or otherwise servicing a FAD, including any electronic equipment used in association with a FAD, in the water or on a vessel while at sea, except that: a FAD may be inspected and handled as needed to identify the owner of the FAD, identify and release incidentally captured animals, un-foul fishing gear, or prevent damage to property or risk to human safety; and
  a FAD may be removed from the water and if removed may be cleaned, provided that it is not returned to the water.
- No submerging lights under water, suspending or hanging lights over the side of the purse seine vessel or any associated skiffs, other watercraft or equipment, or directing or using lights in a manner other than as needed to illuminate the deck of the purse seine vessel or associated skiffs, watercraft or equipment, except as needed to comply with navigational requirements, to ensure the health and safety of the crew, and in emergencies and as needed to prevent human injury or the loss of human life, the loss of the purse seine vessel, skiffs, watercraft or aircraft, or environmental damage.

As discussed in Section 3.2.4 of this PEA, although being more successful at catching fish, FAD sets tend to yield smaller fish, including smaller bigeye and yellowfin tuna, while unassociated sets tend to yield larger fish – primarily skipjack tuna and yellowfin tuna, typically with very few bigeye tuna.

The overall composition of the catch, in terms of both species and fish sizes, made by the fleet would likely be affected by the FAD setting prohibition period. It is expected that there would be a transfer of effort to fishing on unassociated sets during the prohibition period (see Figure 6 in Chapter 3) given that represents the only viable fishing option if vessels continue to operate – so the composition of the catch during those periods would likely consist of less bigeye tuna than would occur under the No-Action Alternative and perhaps more larger yellowfin tuna and skipjack tuna. As shown in Table 3 in Chapter 3, bigeye tuna account for a small percentage of the catch of the U.S. purse seine fleet operating in the WCPO. However, with respect to yellowfin tuna and skipjack tuna, which are caught in substantial amounts in both FAD sets and unassociated sets, the effects of the FAD restrictions are less straightforward. The WCPO stock of yellowfin tuna is expected to be relatively insensitive to a shift to unassociated sets, but recent studies indicate that the stock would be more likely to increase in size than decrease. The effects of the FAD restrictions for WCPO skipjack tuna are not known.

During the FAD setting prohibition period, vessel operators fishing would be able to set only on unassociated schools. This constraint on the type of set that may be made at any given time may adversely affect vessels' profitability depending on the availability of school fish. Vessel operators might be able to mitigate those impacts by choosing to schedule their routine vessel

and equipment maintenance during time when FAD setting is prohibited. Nonetheless, it is conceivable that the FAD restrictions could lead a change in fishing effort by the U.S. WCPO purse seine fleet in the years 2015 through 2020 than would occur without the restrictions. However, as shown in Figure 7 of this PEA, during the FAD restrictions in 2009-2013 (August 1 through September 30 in 2009; July 1 through September 30 in 2010, 2011, and 2012; and July 1 through October 31 in 2013), there was no substantial change in the proportion of the fleet that fished during those months in each of those years when compared to the proportion that fished during those months in 1997-2008 when no FAD restrictions were in place. Thus, little effect on overall fishing effort is expected to result from this element of the alternative. Overall, the three month FAD setting prohibition period is expected to affect the fishing patterns and practices of the fleet by transferring fishing effort from FAD sets to unassociated sets, which could incur additional costs in terms of searching and more sets, as compared to the No-Action Alternative.

4.1.2.3 Yellowfin Tuna Catch Limit[24]

Under this alternative, the yellowfin tuna catch limit for the U.S. WCPO purse seine fishery would be set at 45,363 mt per year for each of the years 2015 through 2020. NMFS could implement the catch limit in the following ways: once the limit has been reached in a given year, (1) NMFS could close the U.S. purse seine fishery in the limit's area of applicability (i.e., no U.S. vessels would be allowed to conduct purse seine fishing in the Convention Area); or (2) NMFS could prohibit U.S. purse seine vessels from retaining on board, landing, or transshipping any catch of yellowfin tuna in the limit's area of application. However, any yellowfin tuna already on board a vessel at the time of the prohibitions going into effect could be retained on board and landed, if landed within a certain amount of time.

NMFS notes that current regulations prohibit yellowfin tuna from being discarded by purse seine vessels unless the fish are unfit for human consumption, there is insufficient well space to retain the fish after the last set of a fishing trip, or a serious malfunction of equipment occurs (see 50 CFR 300.223(d)). Thus, should NMFS prohibit U.S. purse seine vessels from retaining on board, landing, or transshipping yellowfin tuna once the catch limit is reached and the regulations for catch retention remain in effect, vessel owners and operators would essentially be responsible for releasing all yellowfin tuna before it is brought on board. This could result in practical difficulties, since identifying which of the tuna caught is yellowfin tuna before it is brought on board may not be possible. So, if NMFS implements a yellowfin tuna catch limit for U.S. purse seine vessels and the catch retention requirements remain in effect, it is likely that vessel owners and operators would have to stop fishing, regardless of whether NMFS implements a closure of the fishery or implements a prohibition on retention, landing, and transshipment.

Based on the average amount of yellowfin tuna caught by the fleet in the years 1997 to 2013 (26,534 mt based on the data in Table 3), the yellowfin tuna catch limit under this alternative would be expected to be reached toward the end of the year, if at all.

[24] Although the bigeye tuna catch limit for purse seine vessels described in Section 2.1.9 is not analyzed as a specific element of the action alternatives, NMFS notes that the effects from such a catch limit on the operations of the fleet would essentially be the same as those described in this section.

4.1.2.4 Summary of Effects under Alternative B

Overall, Alternative B would be unlikely to substantially affect the fishing patterns and practices of the fleet. Should the fishing effort limit in the ELAPS be reached in any of the years 2015-2020, the fleet could fish more in the EEZs of Pacific Island Parties to the SPTT or in the EPO and could cause a reduction in the total fishing effort of the fleet, but it is unlikely that the limit would be reached under this alternative. The three month FAD setting prohibition period for each calendar year would likely lead to the transfer of some fishing effort from FAD sets to unassociated sets, with consequent impacts in terms of species composition of the catch. The yellowfin tuna catch limit could lead to a closure of the fishery once the catch limit is reached, but it unlikely that the catch limit would be reached under this alternative.

4.1.3 **Alternative C, Most Restrictive Action Alternative**

Under this alternative, the management measures that would affect the U.S. purse seine fleet for each of the calendar years 2015-2020 include a U.S. purse seine fishing effort limit of 432 fishing days on the high seas and 25 fishing days in the U.S. EEZ, a total prohibition on U.S. purse seine fishing for six months, a limit of 1,530 FAD sets, and a yellowfin tuna catch limit of 8,448 for U.S. purse seine vessels. There would also be a prohibition on fishing on FADs on the high seas for U.S. purse seine vessels in 2017 through 2020. These elements for purse seine vessels would apply between the latitudes of 20° N. and 20° S. in the Convention Area, except for territorial seas and archipelagic waters. The potential effects of each of the elements of Alternative C on the fishing patterns and practices of the fleet are described in the following subsections.

4.1.3.1 Fishing Effort Limit

Under Alternative C, it would be highly likely that the fishing effort limits would be reached. Given that the limits on the high seas and in the U.S. EEZ are the lowest levels in recent years, the limits would not be reached only if the high seas or U.S. EEZ proves to be unproductive fishing grounds.

If the limit is reached in any year, vessels in the fleet could continue to fish in the EEZs of Pacific Island Parties to the SPTT, where the fleet has historically spent the majority of its effort. Vessels in the fleet could also continue to fish in the EPO in the area managed by the IATTC.

Under the SPTT, the fleet is likely to have a number of fishing days available in the Pacific Island country EEZs that dominate the western portion of the WCPO. However, oceanographic conditions would determine whether the western fishing grounds are favorable compared with those in the eastern portion of the Convention Area. For 2015, it is evident that El Niño conditions are present and that there is a 60 percent chance they will persist through the northern autumn of 2015 (NWS 2015). This suggests that the eastern portion of the Convention Area will

be favored fishing grounds in most of 2015. Both the ELAPS and the Kiribati EEZ are situated predominantly in the eastern side of the WCPO, and both these areas would be effectively closed to U.S. purse seine fishing during a closure of the high seas or U.S. EEZ in 2015 and perhaps in 2016-2020 as well (the U.S. fleet might have some fishing days available in the Kiribati EEZ, but the number is likely to be small unless new access arrangements are agreed to, which does not appear likely at present). Thus, although fishing in the Convention Area outside the ELAPS might be relatively attractive in terms of next-best opportunities, it would likely bring substantial additional costs to fishing operations. However, if El Niño conditions weaken in 2015 (as indicated above, there is 60% chance of El Niño persisting through the northern autumn) or are not present in 2016-2020, western fishing grounds (e.g., in the EEZs of the Republic of the Marshall Islands and the Federated States of Micronesia) would likely become more favorable. In that case, large portions of both the ELAPS and the Kiribati EEZ would become less favorable, and the adverse economic impacts of a closure on the high seas or U.S. EEZ would be less severe.

With respect to fishing in the EPO, the EPO tends to be fished relatively little by the fleet, indicating it contains relatively unfavorable fishing grounds or conditions (although, as indicated above, it tends to become more favorable during El Niño events) and/or involves prohibitive costs. In order to fish in the EPO, a vessel must be on the IATTC's Regional Vessel Register and categorized as active (50 CFR 300.22(b)), which involves fees of about $14.95 per cubic meter of well space per year (e.g., a vessel with 1,200 m^3 of well space would be subject to annual fees of $17,940).[25] The number of U.S. purse seine vessels in the WCPO fleet that have opted to be categorized as such has recently increased from zero to eleven, probably as a result of the prospect of constraints on fishing opportunities in the WCPO and/or uncertainty in future access arrangements under the SPTT. This suggests a possibility of increasing attractiveness of fishing in the EPO, in spite of the costs associated with doing so.Vessels licensed under the SPTT can each take one fishing trip per year in the area managed by the IATTC, for a period up to 90 days in duration, so long as the total number of trips by all vessels in the fleet does not exceed 32 days per calendar year. In addition, although the IATTC has adopted capacity limits for purse seine vessels operating in the EPO, the United States has a little over 5,000 cubic meters remaining of its allocated capacity (as of March 2015). So, this capacity is available for vessels in the U.S. WCPO purse seine fleet who wish to become active on the IATTC vessel register and fish in the EPO in the area of competence of the IATTC. Although, as of this writing, no U.S. purse seine vessels have shifted to fishing in the EPO.

Overall, 2015-2020 could be years in which the U.S. EEZ or high seas provides more attractive fishing grounds than usual, and in that case, the fleet could be restricted by the effort limits. Indeed, fishing effort in the ELAPS so far in 2015 has been unusually active. This is likely related to the severely limited number of fishing days available in the Kiribati EEZ, as well as the prevailing El Niño conditions, which as described above tend to make the eastern part of the WCPO more favorable fishing grounds than at other times. Additionally, evidence suggests that vessels are catching significant tuna in areas on the high seas but adjacent to the EEZ of Kiribati and these days come at no direct costs to the U.S. operators. Also, as discussed in Chapter 3, the

[25] As an exception to this rule, an SPTT-licensed vessel is allowed to make one fishing trip in the EPO each year without being categorized as active on the IATTC Regional Vessel Register. The trip must not exceed 90 days in length, and there is an annual limit of 32 such trips for the entire SPTT-licensed fleet (50 CFR 300.22(b)(1)).

SPTT is being renegotiated, which may result in changes to the current management regime, including changes to the amount of effort allowed in the EEZs of Pacific Island Parties to the SPTT. Should fishing opportunies outside the ELAPS be reduced from current levels, there would be a greater likelihood of the limits being reached in each of the calendar years.

The effort limits could change the temporal patterns of fishing effort. Since the limits would be a competitive allocation whereby fishing days would not be allocated among individual vessels and would be available to the entire fleet until the cap is reached, some vessel operators have an incentive to fish harder in these two areas earlier in the calendar year than they otherwise would in an attempt to obtain as many fishing days as they can (i.e., "the race to fish") before the limits are reached. To the extent such a shift does occur, it would affect the seasonal timing of deliveries to canneries. A race to fish could also bring costs if it causes vessel operators to forego vessel maintenance or to fish in weather or ocean conditions that it otherwise would not. This could bring costs in terms of human safety as well as the performance of the vessel and its fishing gear and crew, but the effects are not expected to be substantial.

Under this alternative, the limit in one area could be reached before the limit in the other area – i.e., the high seas could be closed to fishing before the U.S. EEZ is closed to fishing or vice versa. Currently only 11 vessels in the fleet are authorized to fish in the U.S. EEZ and some of these vessels deliver to canneries while others transship. So if the limit on the high seas is reached first, the effects would be the same for the majority of the vessels in the fleet; the 11 vessels authorized to fish in the U.S. EEZ may fish harder in the U.S. EEZ than they otherwise would. If the limit in the U.S. EEZ is reached first, the 11 vessels authorized to fish in the U.S. EEZ may fish harder on the high seas than they otherwise would. However, as stated above, other factors, such as climate and ocean conditions, affect the location of optimal fishing grounds for the fleet, and so those other factors would affect whether the 11 vessels authorized to fish in the U.S. EEZ would fish harder in either location if one limit is reached before the other.

Since the fleet generally fishes in areas outside of the ELAPS, it is also possible that there could be no overall change in the amount of fishing effort of the fleet in 2015-2020 compared to the No-Action Alternative.

4.1.3.2 Purse Seine Fishing Closed Period

Under this alternative, purse seine fishing would be prohibited in the Convention Area for six months of each calendar year in 2015 through 2020. For the purposes of analyzing this element of Alternative C, it is assumed that the closure could take place in any six months of the calendar year, rather than for a specific six-month period. As indicated in Figure 7 in Chapter 3, the percentage of licensed vessels that fished is generally constant throughout the year, so it is assumed that the effects of the closure on the fleet would be the same regardless of when it takes place (e.g., a closure from January through June would be expected to have the same effects on the fleet as a closure from January through March and September through November).

As indicated in Table 2, the fishing effort per calendar year in the Convention Area for the U.S. WCPO purse seine fleet varies considerably from year to year. The average fishing effort per calendar year, using data from the years 1997-2013 and not adjusting for the variation in the

number of active fishing vessels, is 5,748 fishing days per year. Adjusting the data for each year to accommodate the maximum number of vessels in fleet (40 vessels) yields an average of 7,438 fishing days per calendar year. Thus, assuming that the fishing effort of the fleet in the Convention Area remains generally the same in 2015 through 2020 as in the past 17 years, a six month total closure of fishing for the fleet could equate to a large reduction in fishing effort. A 50 percent reduction in fishing effort would be a reduction of about 3,719 fishing days per calendar year, though it is unlikely that closing the fishery for 50 percent of the year would equate to a full 50 percent reduction in fishing effort, as effort could increase in the six months of the year when the fishery would remain open.

During the six-month fishing closure, vessels in the fleet would be prohibited from conducting any purse seine fishing operations in the Convention Area. Vessels in the fleet could continue to fish in the EPO in the area managed by the IATTC.[26] As indicated above, with respect to fishing in the EPO, the EPO tends to be fished relatively little by the fleet, indicating it contains relatively unfavorable fishing grounds or conditions (although, as indicated above, it tends to become more favorable during El Niño events) and/or involves prohibitive costs. However, there have been indications of a possible increasing attractiveness of fishing in the EPO, in spite of the costs associated with doing so. Vessels would have no other purse seine fishing opportunities available in the Pacific Ocean during the closure period, so it is likely that many or all vessels in the fleet would cease fishing for most or all of the closure period.

Given the length of the closure period, this element of the alternative would be expected to lead to substantial adverse economic consequences for the fleet. NMFS has recently estimated that the value of annual fleet-wide catches is about $239 million, equivalent to about $656,000 per calendar day (NMFS 2015a). The closure under Alternative C could lead to a large reduction in the revenue generated by the fleet, which, depending on how much of this reduction in revenue is experienced by individual businesses, could cause vessel owners and operators to leave the purse seine fishery and seek other opportunities. Exactly what those opportunities would be is difficult to predict. The one other opportunity that is reasonable to consider for the purposes of this analysis is that vessels may be reflagged to other countries with fleets that operate in the WCPO, since business operations would be more similar to existing business operations than other opportunities (i.e., vessel owners and operators could continue to fish for tuna in the WCPO rather than having to fish for tuna or other species elsewhere or having to undertake training or lifestyle changes to pursue other careers).

4.1.3.3 FAD Set Limit

Under Alternative C, there would be a limit of 1,530 FAD sets in each of the calendar years 2015-2020. Using the data in Table 2 and information regarding the current interim arrangements for the fleet as described in Section 3.2, NMFS believes that the range of 1,500 to 10,000 total sets per year in the Convention Area is a reasonable range of the number of sets that the fleet

[26] Regulations at 50 CFR 300.25(f) require U.S. purse seine vessels to observer one of two closure periods in the EPO in the area managed by the IATTC in 2015 and 2016 – July 29 through September 28 or November 18 through January 18. Should the purse seine fishery closure in the Convention Area overlap with the fishery closure in the EPO, U.S. WCPO purse seine vessels would not have the option of continuing to the fish in the EPO.

would likely make in calendar years 2015-2020.[27] As indicated in Figure 5, the proportion of all sets that are FAD sets ("FAD set ratio") in the U.S WCPO purse seine fishery has varied widely from year to year – from less than 30 percent to more than 90 percent. Thus, it is difficult to predict what the FAD set ratio would be in those periods of 2015-2020 in which FAD sets are allowed. For this analysis, it is assumed that FAD setting patterns in 2015-2020 would be similar to those in the last four years for which complete data are available, 2010-2013 (previous years' data are not used because the fleet was smaller then and there was not 100% observer coverage, as there has been since 2010). Using the information from Table 5, which shows total sets, FAD sets, and fishing days in the U.S. WCPO purse seine fishery from 2010-2013, the estimated number of FAD sets per year under Alternative C would range from 435 to 2,900. Calculations are based on the six-month prohibition on purse seine fishing under this alternative and an average FAD set ratio of 58 percent of total sets made.

The 1,530 FAD set limit would not be expected to be reached under the lower bound estimate of the total number of sets per year but would be expected to be reached under the higher bound estimate of total sets. Predicting when in the calendar year the FAD set limit could be reached under the high bound estimate of total sets is difficult, given that purse seine fishing would be prohibited for an unspecified six months of the calendar year. But given that the FAD set limit is 53 percent of the number of FAD sets that would be expected under the high bound estimate of the total number of sets per year, it is probable that the FAD set limit would be reached after about three months of fishing under that scenario.

In summary, under Alternative C, under the lower bound estimate of total sets per year, fishing on FADs would not be expected to be prohibited for the six months of each year that purse seine fishing would be allowed in the Convention Area, and under the higher bound estimate of total sets per year, fishing on FADs would be expected to be prohibited for approximately three of the six months of each year that purse seine fishing would be allowed in the Convention Area. Should the FAD set limit be reached under this alternative, the fishing patterns and practices of the fleet could be affected by a transfer of fishing effort from FAD sets to unassociated sets, with resulting consequences on the composition of the catch – perhaps more larger yellowfin tuna and more larger skipjack tuna, and likely less bigeye tuna. As shown in Table 3 in Chapter 3, bigeye tuna account for a small percentage of the catch of the U.S. purse seine fleet operating in the WCPO. However, with respect to yellowfin tuna and skipjack tuna, which are caught in substantial amounts in both FAD sets and unassociated sets, the effects of the FAD restrictions are less straightforward. The WCPO stock of yellowfin tuna is expected to be relatively insensitive to a shift to unassociated sets, but recent studies indicate that the stock would be more likely to increase in size than decrease. The effects of the FAD restrictions for WCPO skipjack tuna are not known.

After the FAD set limit is reached in a given year, vessel operators would be able to set only on unassociated schools, and would be subject to the prohibition set forth in Section 4.1.2.2. This constraint on the type of set that may be made at any given time could adversely affect vessels' profitability. Vessel operators might be able to mitigate those impacts by choosing to schedule their routine vessel and equipment maintenance during time when FAD setting is prohibited.

[27] See NMFS (2015b) for more in depth explanation of the development of the range of 1,500 to 10,000 sets per year.

Nonetheless, it is conceivable that the FAD setting restrictions could lead a change in fishing effort by the U.S. WCPO purse seine fleet in the years 2015 through 2020 than would occur without the restrictions. However, as shown in Figure 7 of this PEA, during the FAD restrictions in 2009-2013 (August 1 through September 30 in 2009; July 1 through September 30 in 2010, 2011, and 2012; and July 1 through October 31 in 2013), there was no substantial change in the proportion of the fleet that fished during those months in each of those years when compared to the proportion that fished during those months in 1997-2008 when no FAD restrictions were in place. Thus, little effect on overall fishing effort is expected to result from the FAD restrictions.

4.1.3.4 High Seas FAD Closure

Under this alternative, the U.S. WCPO purse seine fleet would be prohibited from fishing on FADs on the high seas in 2017-2020. Thus, vessel operators would be subject to the prohibitions set forth in Section 4.1.2.2 for the entire year when operating on the high seas. Table 6 shows the number of total sets and FAD sets in the U.S. EEZ, on the high seas and in the EEZs of PIC from 1997-2013. The table indicates that the fleet makes a sizable proportion of FAD sets on the high seas each year in comparison to total sets, but the proportion varies each year. As indicated above and in Table 2, Table 3, and Figure 5, catch, effort, and number of FAD sets for the fleet varies from year to year, and is influenced by various factors, including oceanographic and economic conditions. The data also indicate that the high seas appear to be no different in importance relative to the other fishing grounds in terms of FAD sets. During 1997-2013, on average, the high seas accounted for about 19 percent of total FAD sets— about the same percentage as for all sets. This was also the case in more recent years; in 2009-2013, when FAD closure periods were in effect, the high seas accounted for about 11 percent of all sets, on average, and also about 11 percent of FAD sets.

As indicated in Table 2, the fleet spent an average of approximately 5 percent of its total effort per year in the U.S. EEZ and 18 percent of its total effort per year on the high seas (in terms of days fished), and the remainder (or 77 percent) in the EEZs of Pacific Island Parties to the SPTT. Thus, under Alternative C, the fleet would still be able to fish on FADs throughout the six months of the calendar year in 2017-2020 when fishing is allowed in locations where the majority of its effort is spent, unless the FAD set limit is reached, as discussed in Section 4.1.3.3 above.

The prohibition on fishing on FADs on the high seas could cause the fleet to transfer some of its effort from associated sets to unassociated sets, if it continues to fish at the same rate on the high seas, or could cause the fleet transfer its effort from the high seas to the U.S. EEZ or to PIC EEZs, so that it could fish more on FADs in the U.S. EEZ or in the EEZ of PIC. Should the high seas FAD setting prohibition result in fewer overall FAD sets, there could be resulting consequences on the composition of the catch – perhaps more larger yellowfin tuna and more larger skipjack tuna, and likely less bigeye tuna. As shown in Table 3 in Chapter 3, bigeye tuna account for a small percentage of the catch of the U.S. purse seine fleet operating in the WCPO. However, with respect to yellowfin tuna and skipjack tuna, which are caught in substantial amounts in both FAD sets and unassociated sets, the effects of the FAD restrictions are less straightforward. The WCPO stock of yellowfin tuna is expected to be relatively insensitive to a shift to unassociated sets, but recent studies indicate that the stock would be more likely to

increase in size than decrease. The effects of the FAD restrictions for WCPO skipjack tuna are not known.

As stated above, as shown in Figure 7 of this PEA, during the FAD restrictions in 2009-2013 (August 1 through September 30 in 2009; July 1 through September 30 in 2010, 2011, and 2012; and July 1 through October 31 in 2013), there was no substantial change in the proportion of the fleet that fished during those months in each of those years when compared to the proportion that fished during those months in 1997-2008 when no FAD setting restrictions were in place. In addition, the fleet would be able to fish on FADs in the U.S. EEZ and PIC EEZs when the high seas are closed to FAD fishing. Also, under Alternative C, it is highly likely that the fishing effort limit on the high seas and in the U.S. EEZ would be reached in a calendar year, so the fleet would be expected to spend more time fishing in PIC EEZs regardless of the FAD setting prohibitions on the high seas. Thus, little effect on overall fishing effort is expected to result from the high seas FAD closure in 2017-2020.

4.1.3.5 Yellowfin Tuna Catch Limit[28]

Under this alternative, the yellowfin tuna catch limit for the U.S. WCPO purse seine fishery would be set at 8,448 mt per year for each of the years 2015 through 2020. NMFS could implement the catch limit in the following ways: once the limit has been reached in a given year, (1) NMFS could close the U.S. purse seine fishery in the limit's area of applicability (i.e., no U.S. vessels would be allowed to conduct purse seine fishing in the Convention Area); or (2) NMFS could prohibit U.S. purse seine vessels from retaining on board, landing, or transshipping any catch of yellowfin tuna in the limit's area of application. However, any yellowfin tuna already on board a vessel at the time of the prohibitions going into effect could be retained on board and landed, if landed within a certain amount of time.

NMFS notes that current regulations prohibit yellowfin tuna from being discarded by purse seine vessels unless the fish are unfit for human consumption, there is insufficient well space to retain the fish after the last set of a fishing trip, or a serious malfunction of equipment occurs (see 50 CFR 300.223(d)). Thus, should NMFS prohibit U.S. purse seine vessels from retaining on board, landing, or transshipping yellowfin tuna once the catch limit is reached and the regulations for catch retention remain in effect, vessel owners and operators would essentially be responsible for releasing all yellowfin tuna before it is brought on board. This could result in practical difficulties, since identifying which of the tuna caught is yellowfin tuna before it is brought on board may not be possible and mortality will be incurred despite the retention prohibition. So, if NMFS implements a yellowfin tuna catch limit for U.S. purse seine vessels and the catch retention requirements remain in effect, it is likely that vessel owners and operators would have to stop fishing, regardless of whether NMFS implements a closure of the fishery or implements a prohibiton on retention, landing, and transshipment to make the measure effective.

[28] Although the bigeye tuna catch limit for purse seine vessels described in Section 2.1.9 is not analyzed as a specific element of the action alternatives, NMFS notes that the effects from such a catch limit on the operations of the fleet would essentially be the same as those described in this section.

Based on the average amount of yellowfin tuna caught by the fleet in the years 1997 to 2013 (26,534 mt based on the data in Table 3), the yellowfin tuna catch limit under this alternative would be expected to be reached after the fleet fishes for approximately four months during a calendar year. Thus, this alternative could lead to a closure of the fishery for eight months each calendar year.

Given the length of the potential closure period, this element of the alternative would be expected to lead to substantial adverse economic consequences for the fleet. NMFS has recently estimated that the value of annual fleet-wide catches is about $239 million, equivalent to about $656,000 per calendar day (NMFS 2015a). The closure due to reaching the yellowfin tuna catch limit could lead to a 67 percent reduction in the revenue generated by the fleet, which, depending on how much of this reduction in revenue is experienced by individual businesses, could cause vessel owners and operators to leave the purse seine fishery and seek other opportunities. Exactly what those opportunities would be is difficult to predict. The one other opportunity that is reasonable to consider for the purposes of this analysis is that vessels may be reflagged to other countries with fleets that operate in the WCPO, since business operations would be more similar to existing business operations than other opportunities (i.e., vessel owners and operators could continue to fish for tuna in the WCPO rather than having to fish for tuna or other species elsewhere or having to undertake training or lifestyle changes to pursue other careers).

4.1.3.6 Summary of Effects under Alternative C

Under Alternative C, the purse seine effort limit of 432 fishing days on the high seas and 25 fishing days in the U.S. EEZ would be likely to be reached in each of the calendar years 2015-2020, which could either reduce overall purse seine fishing effort or shift effort to PIC EEZs or the EPO. The six-month total fishery closure could substantially reduce purse seine fishing effort in the Convention Area, which could lead to vessel owners and operators leaving the fishery and seeking other opportunities. If the FAD set limit is reached in any of the calendar years, fishing effort could be transferred to unassociated sets, with resulting consequences on the composition of the catch – perhaps more larger yellowfin and skipjack tuna and likely less bigeye tuna. As shown in Table 3 in Chapter 3, bigeye tuna account for a small percentage of the catch of the U.S. purse seine fleet operating in the WCPO. However, with respect to yellowfin tuna and skipjack tuna, which are caught in substantial amounts in both FAD sets and unassociated sets, the effects of the FAD restrictions are less straightforward. The WCPO stock of yellowfin tuna is expected to be relatively insensitive to a shift to unassociated sets, but recent studies indicate that the stock would be more likely to increase in size than decrease. The effects of the FAD restrictions for WCPO skipjack tuna are not known. The high seas FAD setting prohibition period in each of the calendar years 2017-2020 could also transfer effort to unassociated sets on the high seas or to FAD sets in the U.S. EEZ or in PIC EEZs. It is likely that the yellowfin tuna catch limit would be reached, which would likely result in a closure of the fishery. A rough approximation is that the yellowfin tuna catch limit would be reached after the fleet fishes for four months of a calendar year. Thus, overall it is likely that under Alternative C, the U.S. WCPO purse seine fleet would be able to fish in the Convention Area for roughly four months each calendar year, and could be subject to FAD restrictions in some of those months each year (due to the FAD set limit and the prohibition on fishing on FADs on the high seas in 2017-2020),

and would fish more in PIC EEZs than elsewhere, due to the fishing day effort limits in the U.S. EEZ and on the high seas.

4.1.4 **Alternative D, Most Restrictive FAD setting prohibition Period Variation**

This alternative would be the same as Alternative C, except that instead of a total prohibition on U.S. purse seine fishing for six months and a FAD set limit, there would be a FAD setting prohibition period for the full year. Thus, under this alternative, there would be a transfer of purse seine fishing from FAD sets to unassociated sets for the full year for 2015-2020 so the composition of the catch during those years would perhaps consist of more larger yellowfin and skipjack tuna and likely less bigeye tuna. As shown in Table 3 in Chapter 3, bigeye tuna account for a small percentage of the catch of the U.S. purse seine fleet operating in the WCPO. However, with respect to yellowfin tuna and skipjack tuna, which are caught in substantial amounts in both FAD sets and unassociated sets, the effects of the FAD restrictions are less straightforward. The WCPO stock of yellowfin tuna is expected to be relatively insensitive to a shift to unassociated sets, but recent studies indicate that the stock would be more likely to increase in size than decrease. The effects of the FAD restrictions for WCPO skipjack tuna are not known.

It is conceivable that the FAD setting restrictions could lead to a change in fishing effort by the U.S. WCPO purse seine fleet in the years 2015 through 2020 than would occur without the restrictions. However, as shown in Figure 7 of this PEA, during the FAD restrictions in 2009-2013 (August 1 through September 30 in 2009; July 1 through September 30 in 2010, 2011, and 2012; and July 1 through October 31 in 2013), there was no substantial change in the proportion of the fleet that fished during those months in each of those years when compared to the proportion that fished during those months in 1997-2008 when no FAD restrictions were in place. Thus, little effect on overall fishing effort is expected to result from the FAD restrictions.

The effects on the fishing patterns and practices of the fleet from the remaining elements of Alternative D would be identical to those under Alternative C.

4.1.5 **Alternative E, Additional FAD Setting Prohibition Period**

This alternative would be the same as Alternative B, except that instead of a three month FAD setting prohibition period, there would be a four-month FAD setting prohibition period each year. Thus, under this alternative, there would be an additional month during which there would be transfer of purse seine fishing from FAD sets to unassociated sets, with resulting consequences on the composition of the catch – probably more larger yellowfin and skipjack tuna and likely less bigeye tuna. As shown in Table 3 in Chapter 3, bigeye tuna account for a small percentage of the catch of the U.S. purse seine fleet operating in the WCPO. However, with respect to yellowfin tuna and skipjack tuna, which are caught in substantial amounts in both FAD sets and unassociated sets, the effects of the FAD restrictions are less straightforward. The WCPO stock of yellowfin tuna is expected to be relatively insensitive to a shift to unassociated sets, but recent studies indicate that the stock would be more likely to increase in size than decrease. The effects of the FAD restrictions for WCPO skipjack tuna are not known.

During the FAD setting prohibition period, vessel operators would be able to set only on unassociated schools. This constraint on the type of set that may be made at any given time could adversely affect vessels' profitability. Vessel operators might be able to mitigate those impacts by choosing to schedule their routine vessel and equipment maintenance during time when FAD setting is prohibited. Nonetheless, it is conceivable that the FAD setting restrictions could lead to less fishing effort by the U.S. WCPO purse seine fleet in the years 2015 through 2020 than would occur without the restrictions. However, as shown in Figure 7 of this PEA, during the FAD setting restrictions in 2009-2013 (August 1 through September 30 in 2009; July 1 through September 30 in 2010, 2011, and 2012; and July 1 through October 31 in 2013), there was no substantial change in the proportion of the fleet that fished during those months in each of those years when compared to the proportion that fished during those months in 1997-2008 when no FAD restrictions were in place. Thus, little effect on overall fishing effort is expected to result from the FAD setting prohibition period.

The effects on fishing patterns and practices of the fleet from the remaining elements of Alternative E would be identical to those under Alternative B.

4.1.6 **Alternative F, FAD Set Limit Variation**

This alternative would be the same as Alternative B, except that there would also be a limit of 2,522 FAD sets per year. As stated above, NMFS believes that the range of 1,500 to 10,000 total sets per year in the Convention Area is a reasonable range of the number of sets that the fleet would likely make in calendar years 2015-2020. As indicated in Figure 5, the proportion of all sets that are FAD sets ("FAD set ratio") in the U.S WCPO purse seine fishery has varied widely from year to year – from less than 30 percent to more than 90 percent. Thus, it is difficult to predict what the FAD set ratio would be in those periods of 2015-2020 in which FAD sets are allowed. For this analysis, it is assumed that FAD set patterns in 2015-2020 would be similar to those in the last four years for which complete data are available, 2010-2013 (previous years' data are not used because the fleet was smaller then and there was not 100% observer coverage, as there has been since 2010). Using the information from Table 5, which shows total sets, FAD sets, and fishing days in the U.S. WCPO purse seine fishery from 2010-2013, the estimated number of FAD sets per year under Alternative F would range from 870 to 5,800. Calculations are based on a 58 percent FAD set ratio.

The 2,522 FAD set limit would not be expected to be reached under the lower bound estimate of the total number of sets per year but would be expected to be reached under the higher bound estimate of total sets. Given that the FAD set limit is 43 percent of the number of FAD sets that would be expected under the high bound estimate of the total number of sets per year, it is probable that the FAD set limit would be reached in May or June of each calendar year.

In summary, under Alternative F, under the lower bound estimate of total sets per year, fishing on FADs would be expected to be prohibited only during the three month FAD setting prohibition period, and under the higher bound estimate of total sets per year, fishing on FADs would be expected to be prohibited for approximately six to seven months of each year (assuming the three-month FAD setting prohibition period overlaps with the time period after the FAD set limit is reached). Should the FAD set limit be reached under this alternative, the fishing

patterns and practices of the fleet could be affected by an additional transfer of fishing effort from FAD sets to unassociated sets after the limit is reached and FAD sets are prohibited than under Alternative B, with resulting consequences on the composition of the catch – perhaps more larger yellowfin and skipjack tuna and likely less bigeye tuna. As shown in Table 3 in Chapter 3, bigeye tuna account for a small percentage of the catch of the U.S. purse seine fleet operating in the WCPO. However, with respect to yellowfin tuna and skipjack tuna, which are caught in substantial amounts in both FAD sets and unassociated sets, the effects of the FAD restrictions are less straightforward. The WCPO stock of yellowfin tuna is expected to be relatively insensitive to a shift to unassociated sets, but recent studies indicate that the stock would be more likely to increase in size than decrease. The effects of the FAD restrictions for WCPO skipjack tuna are not known.

As for the FAD setting prohibition period, after the FAD set limit is reached in a given year, vessel operators would be able to set only on unassociated schools. This constraint on the type of set that may be made at any given time would be expected to adversely affect vessels' profitability. Vessel operators might be able to mitigate those impacts by choosing to schedule their routine vessel and equipment maintenance during time when FAD setting is prohibited. Nonetheless, it is conceivable that the FAD set limit could lead to less fishing effort by the U.S. WCPO purse seine fleet in the years 2015 through 2020 than would occur without the limit. However, as shown in Figure 7 of this PEA, during the FAD restrictions in 2009-2013 (August 1 through September 30 in 2009; July 1 through September 30 in 2010, 2011, and 2012; and July 1 through October 31 in 2013), there was no substantial change in the proportion of the fleet that fished during those months in each of those years when compared to the proportion that fished during those months in 1997-2008 when no FAD restrictions were in place. Thus, little effect on overall fishing effort is expected to result from the FAD set limit.

The effects on fishing patterns and practices of the fleet from the remaining elements of Alternative F would be identical to those under Alternative B.

4.1.7 **Alternative G, Total Purse Seine Closure Variation**

This alternative would be the same as Alternative B, except that instead of a three month FAD setting prohibition period, there would be a total prohibition on U.S. purse seine fishing for three months each year.

For the purposes of analyzing this element of Alternative G, it is assumed that the closure could take place in any three months of the calendar year, rather than for a specific three-month period. As indicated in Figure 7, in Chapter 3, the percentage of licensed vessels that fished is generally constant throughout the year, so it is assumed that the effects of the closure on the fleet would be the same regardless of when it takes place (e.g., a closure from January through March would be expected to have the same effects on the fleet as a closure from July through September).

As indicated in Table 2, the fishing effort per calendar year in the Convention Area for the U.S. WCPO purse seine fleet varies considerably from year to year. The average fishing effort per calendar year, using data from the years 1997-2013 and not adjusting for the variation in the number of active fishing vessels, is 5,748 fishing days per year. Adjusting the data for each year

to accommodate the maximum number of vessels in fleet (40 vessels) yields an average of 7,438 fishing days per calendar year. Thus, assuming that the fishing effort of the fleet in the Convention Area remains generally the same in 2015 through 2020 as in the past 17 years, a three month total closure of fishing for the fleet could lead to a large reduction in fishing effort. A 25 percent reduction in fishing effort would be a reduction of about 1,860 fishing days, though it is unlikely that a three-month closure of the fishery would lead to a 25 percent reduction in fishing effort, since the fleet would likely increase its effort in the other months of the year when the fishery would be open.

During the three-month fishing closure, vessels in the fleet would be prohibited from conducting any purse seine fishing operations in the Convention Area. Vessels in the fleet could continue to fish in the EPO in the area managed by the IATTC.[29] As indicated above, with respect to fishing in the EPO, the EPO tends to be fished relatively little by the fleet, indicating it contains relatively unfavorable fishing grounds (although, as indicated above, it tends to become more favorable during El Niño events) and/or involves prohibitive costs. However, there have been indications of a possible increasing attractiveness of fishing in the EPO, in spite of the costs associated with doing so. Although, as of this writing, no U.S. purse seine vessels have shifted to fishing in the EPO. Vessels would have no other purse seine fishing opportunities available in the Pacific Ocean during the closure period, so it is likely that many or all vessels in the fleet would cease fishing for most or all of the closure period.

Given the length of the closure period, this element of Alternative G would be expected to lead to substantial adverse economic consequences for the fleet. NMFS has recently estimated that the value of annual fleet-wide catches is about $239 million, equivalent to about $656,000 per calendar day (NMFS 2015a). The closure under Alternative G could lead to a large reduction in the revenue generated by the fleet, which, depending on how much of this reduction in revenue is experienced by individual businesses, could cause vessel owners and operators to leave the purse seine fishery and seek other opportunities. Exactly what those opportunities would be is difficult to predict. The one other opportunity that is reasonable to consider for the purposes of this analysis is that vessels may be reflagged to other countries with fleets that operate in the WCPO, since business operations would be more similar to existing business operations than other opportunities (i.e., vessel owners and operators could continue to fish for tuna in the WCPO rather than having to fish for tuna or other species elsewhere or having to undertake training or lifestyle changes to pursue other careers).

The effects on fishing patterns and practices of the fleet from the remaining elements of Alternative G would be identical to those under Alternative B. However, should the three-month closure period overlap with the three-month FAD setting prohibition period, then the transfer of fishing effort to unassociated sets during the FAD setting prohibition period with resulting consequences on the composition of the catch – perhaps more larger yellowfin and skipjack tuna and likely less bigeye tuna – would not be expected to occur.

[29] Regulations at 50 CFR 300.25(f) require U.S. purse seine vessels to observer one of two closure periods in the EPO in the area managed by the IATTC in 2015 and 2016 – July 29 through September 28 or November 18 through January 18. Should the purse seine fishery closure in the Convention Area overlap with the fishery closure in the EPO, U.S. WCPO purse seine vessels would not have the option of continuing to the fish in the EPO.

4.1.8 **Alternative H, Most Restrictive Without High Seas FAD Closure**

This alternative would be the same as Alternative C, except that there would be no prohibition on fishing on FADs on the high seas for U.S. purse seine vessels in 2017 through 2020. Thus the effects to the fishing patterns and practices of the fleet would be the same as under Alternative C, except that there would be no potential additional transfer of fishing effort from FAD sets to unassociated sets on the high seas or to FAD sets in the U.S. EEZ and in PIC EEZs in calendar years 2017-2020 from a FAD setting prohibition period on the high seas.

4.1.9 **Alternative I, Variation on Purse Seine Fishing Effort Limits**

This alternative would be the same as Alternative B, except that the U.S. purse seine fishing effort limit would be 1,828 fishing days per year in the ELAPS. As indicated in Table 2 in Chapter 3 of this PEA, from the years 1997 through 2013, the fleet spent an average of approximately 5 percent of its total effort per year in the U.S. EEZ and 18 percent of its total effort per year on the high seas, and the remainder (or 77 percent) in the EEZs of Pacific Island Parties to the SPTT. Given that the fishing effort limit in the ELAPS under this alternative exceeds the average number of days fished in the ELAPS during the years 1997 through 2013 slightly (by about 500 fishing days), it is uncertain whether the limit would be reached under this alternative for each of the years 2015-2020. However, should the limit be reached, the fishery would be closed on the high seas and in the U.S. EEZ for the remainder of the calendar year. The length of any such closure cannot be predicted with any degree of certainty, due to the large variation in the number of days fished in the U.S. EEZ and on the high seas from year to year, as shown in Table 2. As indicated in Chapter 2, NMFS has implemented the 1,828 fishing day purse seine effort limit in the ELAPS for 2015, and has closed the fishery in the ELAPS from June 15, 2015 through the end of the calendar year.[30]

If the limit is reached in any year, vessels in the fleet could continue to fish in the EEZs of Pacific Island Parties to the SPTT, where the fleet expends the majority of its effort. Vessels in the fleet could also continue to fish in the EPO in the area managed by the IATTC.

Under the SPTT, the fleet is likely to have a large number of fishing days available in the Pacific Island country EEZs that dominate the western portion of the WCPO. However, oceanographic conditions would determine whether the western fishing grounds are favorable compared with those in the eastern portion of the Convention Area. For 2015, it is evident that El Niño conditions are present and that there is a 60 percent chance they will persist through the northern autumn of 2015 (NWS 2015). This suggests that the eastern portion of the Convention Area will be favored fishing grounds in most of 2015. Both the ELAPS and the Kiribati EEZ are situated predominantly in the eastern side of the WCPO, and both these areas would be effectively closed to U.S. purse seine fishing during an ELAPS closure in 2015 and perhaps in 2016-2020 as well (the U.S. fleet might have some fishing days available in the Kiribati EEZ, but the number is likely to be small unless new access arrangements are agreed to, which does not appear likely at present). Thus, although fishing in the Convention Area outside the ELAPS might be relatively attractive in terms of next-best opportunities, it would likely bring substantial additional costs to

[30] See 80 FR 32313, published June 8, 2015.

fishing operations. However, if El Niño conditions weaken in 2015 (as indicated above, there is 60% chance of El Niño persisting through the northern autumn) or are not present in 2016-2020, western fishing grounds (e.g., in the EEZs of the Republic of the Marshall Islands and the Federated States of Micronesia) would likely become more favorable. In that case, large portions of both the ELAPS and the Kiribati EEZ would become less favorable, and the adverse economic impacts of an ELAPS closure would be less severe.

With respect to fishing in the EPO, the EPO tends to be fished relatively little by the fleet, indicating it contains relatively unfavorable fishing grounds or conditions (although, as indicated above, it tends to become more favorable during El Niño events) and/or involves prohibitive costs. In order to fish in the EPO, a vessel must be on the IATTC's Regional Vessel Register and categorized as active (50 CFR 300.22(b)), which involves fees of about $14.95 per cubic meter of well space per year (e.g., a vessel with 1,200 m^3 of well space would be subject to annual fees of $17,940).[31] The number of U.S. purse seine vessels in the WCPO fleet that have opted to be categorized as such has recently increased from zero to eleven, probably as a result of constraints on fishing days in the WCPO and/or uncertainty in future access arrangements under the SPTT. This suggests a possibility of an increasing attractiveness of fishing in the EPO, in spite of the costs associated with doing so.Vessels licensed under the SPTT can each take one fishing trip per year in the area managed by the IATTC, for a period up to 90 days in duration, so long as the total number of trips by all vessels in the fleet does not exceed 32 days per calendar year. In addition, although the IATTC has adopted capacity limits for purse seine vessels operating in the EPO, the United States has a little over 5,000 cubic meters remaining of its allocated capacity (as of March 2015). So, this capacity is available for vessels in the U.S. WCPO purse seine fleet who wish to become active on the IATTC vessel register and fish in the EPO in the area of competence of the IATTC. Although, as of this writing, no U.S. purse seine vessels have shifted to fishing in the EPO.

Overall, 2015-2020 could be years in which the U.S. EEZ or high seas provides more attractive fishing grounds than usual, and in that case, the fleet could be restricted by the effort limits. Indeed, fishing effort in the ELAPS so far in 2015 has been unusually active. This is likely related to the severely limited number of fishing days available in the Kiribati EEZ, as well as the prevailing El Niño conditions, which as described above tend to make the eastern part of the WCPO more favorable fishing grounds than at other times. Also, as discussed in Chapter 3, the SPTT is being renegotiated, which may result in changes to the current management regime, including changes to the amount of effort allowed in the EEZs of Pacific Island Parties to the SPTT. Should fishing opportunies outside the ELAPS be reduced from current levels, there would be a greater likelihood of the limit being reached earlier in the year.

The effort limit could change the temporal patterns of fishing effort. Since the limit would be a competitive allocation whereby fishing days would not be allocated among individual vessels and would be available to the entire fleet until the cap is reached, some vessel operators might have an incentive to fish harder in these two areas earlier in the calendar year than they otherwise would in an attempt to obtain as many fishing days as they can (i.e., "the race to fish") before the

[31] As an exception to this rule, an SPTT-licensed vessel is allowed to make one fishing trip in the EPO each year without being categorized as active on the IATTC Regional Vessel Register. The trip must not exceed 90 days in length, and there is an annual limit of 32 such trips for the entire SPTT-licensed fleet (50 CFR 300.22(b)(1)).

limit is reached. To the extent such a shift does occur, it could affect the seasonal timing of deliveries to canneries. A race to fish could also bring costs if it causes vessel operators to forego vessel maintenance or to fish in weather or ocean conditions that it otherwise would not. This could bring costs in terms of human safety as well as the performance of the vessel and its fishing gear and crew, but the effects are not expected to be substantial, as the fleet does not exert the majority of its fishing effort in the ELAPS.

In addition, since the fleet generally fishes in areas outside of the ELAPS, it is possible that there could be no overall change in the amount of fishing effort of the fleet in 2015-2020 compared to the No-Action Alternative.

The effects on fishing patterns and practices of the fleet from the remaining elements of Alternative I would be identical to those under Alternative B.

4.1.10 **Alternative J, Variation on Purse Seine Fishing Effort Limits, Separate Areas**

This alternative would the same as Alternative B, except that the U.S. purse seine fishing effort limits would be 1,270 fishing days per year on the high seas and 558 fishing days per year in the U.S. EEZ. As indicated in Table 2 in Chapter 3 of this PEA, from the years 1997 through 2013, the fleet spent an average of approximately 5 percent of its total effort per year in the U.S. EEZ and 18 percent of its total effort per year on the high seas, and the remainder (or 77 percent) in the EEZs of Pacific Island Parties to the SPTT. Given that the fishing effort limits in on the high seas and the U.S. EEZ under this alternative exceeds the average number of days fished in those areas during the years 1997 through 2013 slightly (by about 200 fishing days on for the high seas and about 300 fishing days for the U.S. EEZ), it is uncertain whether the limits would be reached under this alternative for each of the years 2015-2020. However, should either or both of the limits be reached, the fishery would be closed on the high seas or in the U.S. EEZ for the remainder of the calendar year. The length of any such closure cannot be predicted with any degree of certainty, due to the large variation in the number of days fished in the U.S. EEZ and on the high seas from year to year, as shown in Table 2. Based on information for 2015 to date, it appears that the limit on the high seas under this alternative was reached in May 2015 and that the limit for the U.S. EEZ would be unlikely to be reached in 2015.

If the limits are reached in any year, vessels in the fleet could continue to fish in the EEZs of Pacific Island Parties to the SPTT, where the fleet expends the majority of its effort. Vessels in the fleet could also continue to fish in the EPO in the area managed by the IATTC.

Under the SPTT, the fleet is likely to have a number of fishing days available in the Pacific Island country EEZs that dominate the western portion of the WCPO. However, oceanographic conditions would determine whether the western fishing grounds are favorable compared with those in the eastern portion of the Convention Area. For 2015, it is evident that El Niño conditions are present and that there is a 60 percent chance they will persist through the northern autumn of 2015 (NWS 2015). This suggests that the eastern portion of the Convention Area will be favored fishing grounds in most of 2015. Both the ELAPS and the Kiribati EEZ are situated predominantly in the eastern side of the WCPO, and both these areas would be effectively closed to U.S. purse seine fishing during an ELAPS closure in 2015 and perhaps in 2016-2020 as well

(the U.S. fleet might have some fishing days available in the Kiribati EEZ, but the number is likely to be small unless new access arrangements are agreed to, which does not appear likely at present). Thus, although fishing in the Convention Area outside the ELAPS might be relatively attractive in terms of next-best opportunities, it would likely bring substantial additional costs to fishing operations. However, if El Niño conditions weaken in 2015 (as indicated above, there is 60% chance of El Niño persisting through the northern autumn) or are not present in 2016-2020, western fishing grounds (e.g., in the EEZs of the Republic of the Marshall Islands and the Federated States of Micronesia) would likely become more favorable. In that case, large portions of both the ELAPS and the Kiribati EEZ would become less favorable, and the adverse economic impacts of a closure of the high seas or U.S. EEZ would be less severe.

With respect to fishing in the EPO, the EPO tends to be fished relatively little by the fleet, indicating it contains relatively unfavorable fishing grounds (although, as indicated above, it tends to become more favorable during El Niño events) and/or involves prohibitive costs. In order to fish in the EPO, a vessel must be on the IATTC's Regional Vessel Register and categorized as active (50 CFR 300.22(b)), which involves fees of about $14.95 per cubic meter of well space per year (e.g., a vessel with 1,200 m^3 of well space would be subject to annual fees of $17,940).[32] The number of U.S. purse seine vessels in the WCPO fleet that have opted to be categorized as such has recently increased from zero to eleven, probably as a result of constraints on fishing days in the WCPO and/or uncertainty in future access arrangements under the SPTT. This suggests an increasing attractiveness of fishing in the EPO, in spite of the costs associated with doing so. Vessels licensed under the SPTT can each take one fishing trip per year in the area managed by the IATTC, for a period up to 90 days in duration, so long as the total number of trips by all vessels in the fleet does not exceed 32 days per calendar year. In addition, although the IATTC has adopted capacity limits for purse seine vessels operating in the EPO, the United States has a little over 5,000 cubic meters remaining of its allocated capacity (as of March 2015). So, this capacity is available for some vessels in the U.S. WCPO purse seine fleet who wish to become active on the IATTC vessel register and fish in the EPO in the area of competence of the IATTC. Although, as of this writing, no U.S. purse seine vessels have shifted to fishing in the EPO.

Overall, 2015-2020 could be years in which the U.S. EEZ or high seas provides more attractive fishing grounds than usual, and in that case, the fleet could be restricted by the effort limits. Indeed, fishing effort in the ELAPS so far in 2015 has been unusually great. This is likely related to the severely limited number of fishing days available in the Kiribati EEZ, as well as the prevailing El Niño conditions, which as described above tend to make the eastern part of the WCPO more favorable fishing grounds than at other times. Also, as discussed in Chapter 3, the SPTT is being renegotiated, which may result in changes to the current management regime, including changes to the amount of effort allowed in the EEZs of Pacific Island Parties to the SPTT. Should fishing opportunies outside the ELAPS be reduced from current levels, there would be a greater likelihood of the limit being reached.

[32] As an exception to this rule, an SPTT-licensed vessel is allowed to make one fishing trip in the EPO each year without being categorized as active on the IATTC Regional Vessel Register. The trip must not exceed 90 days in length, and there is an annual limit of 32 such trips for the entire SPTT-licensed fleet (50 CFR 300.22(b)(1)).

The effort limits could change the temporal patterns of fishing effort. Since the limits would be a competitive allocation whereby fishing days would not be allocated among individual vessels and would be available to the entire fleet until the cap is reached, some vessel operators might have an incentive to fish harder in these two areas earlier in the calendar year than they otherwise would in an attempt to obtain as many fishing days as they can (i.e., “the race to fish”) before the limit is reached. To the extent such a shift does occur, it would affect the seasonal timing of deliveries to canneries. A race to fish could also bring costs if it causes vessel operators to forego vessel maintenance or to fish in weather or ocean conditions that it otherwise would not. This could bring costs in terms of human safety as well as the performance of the vessel and its fishing gear and crew, but the effects are not expected to be substantial, as the fleet does not exerts the majority of its fishing effort in the ELAPS. This race to fish effect could also be expected in the time period between when a closure of the fishery is announced and when the fishery is closed.

In addition, since the fleet generally fishes in areas outside of the ELAPS, it is possible that there could be no overall change in the amount of fishing effort of the fleet in 2015-2020 compared to the No-Action Alternative.

Alternative J would be essentially the same as Alternative I except that under Alternative J, the U.S. purse seine fishery on the high seas and in the U.S. EEZ could be closed at different times. i.e., the high seas could be closed to fishing before the U.S. EEZ is closed to fishing or vice versa. Currently only 11 vessels in the fleet are authorized to fish in the U.S. EEZ, so if the limit on the high seas is reached first, the effects would be the same for the majority of the vessels in the fleet; the 11 vessels authorized to fish in the U.S. EEZ may fish harder in the U.S. EEZ than they otherwise would. If the limit in the U.S. EEZ is reached first, the 11 vessels authorized to fish in the U.S. EEZ may fish harder on the high seas than they otherwise would. However, as stated above, other factors, such as climate and ocean conditions, affect the location of optimal fishing grounds for the fleet, and so those other factors would affect whether the 11 vessels authorized to fish in the U.S. EEZ would fish harder in either location if one limit is reached before the other. Based on available data, it is likely that the high seas would be closed for a longer period of time in 2015 than would the U.S. EEZ, and likely that the limit in the U.S. EEZ would not be reached in 2015; similar circumstances could arise in 2016-2020.

The effects on fishing patterns and practices of the fleet from the remaining elements of Alternative J would be identical to those under Alternative B.

4.1.11 **Alternative K, Multiyear Limits**

This alternative would be the same as Alternative B for the purse seine fleet, except that the purse seine fishing effort limit and the purse seine yellowfin tuna catch limit would be applied on a multiyear basis. Rather than being calendar year annual limits, all of these limits would be applied to three-year periods. This alternative would allow for more operational flexibility for the fleet. As indicated in Table 2 and Table 3, the fishing effort of the fleet as well as the catch of the fleet varies considerably from year to year and is largely dependent on oceanographic and economic factors. With multiyear effort and catch limits, the fleet could take advantage of this

variability and fish more in one year and less in another year without exceeding a specific calendar year limit. Thus, it is less likely that the effort and catch limits would be reached under this alternative than under Alternative B.

4.2 *The Hawaii-Based Deep-Set and Shallow-Set Longline Fisheries*

The direct and indirect effects to the Hawaii-Based Deep-Set and Shallow-Set Longline Fisheries from implementation of each of the alternatives would fall into two categories: (1) economic; and (2) changes to fishing patterns and practices. General information regarding economic impacts is provided in the discussion below to help compare the alternatives assessed and to determine whether the economic impacts are interrelated with environmental impacts. More specific information regarding economic impacts would be provided for each regulatory action undertaken by NMFS to implement the elements of the proposed action (i.e., an action taken under one of the administrative processes outlined in Section 1.3 of this PEA) through preparation of a Regulatory Impact Review (RIR), prepared under Executive Order 12866. The potential impacts from implementation of each of the alternatives to each of the potentially affected resources are analyzed in Sections 4.4 to 4.9.

4.2.1 **Alternative A, the No-Action Alternative**

Under Alternative A, the No-Action Alternative, the management measures for the Hawaii-based deep-set and shallow-set longline fisheries would continue to be managed under existing regulatory requirements. Thus, under this alternative there would be no direct changes to the fishing patterns and practices of the fleet.

As described in Section 1.4 of this PEA, the purpose of the proposed action is to contribute to the underlying objectives of the Commission's management of tropical tuna stocks in the WCPO, which, as stated in CMM 2014-01, are to reduce or maintain their respective fishing mortality rates at levels no greater than those rates associated with maximum sustainable yield, and as reflected in the Commission's limit reference points for these stocks, are to avoid the spawning stocks becoming smaller than 20 percent of the estimated spawning stock size in the absence of fishing. As stated in Section 3.5 of this PEA, Pacific bigeye tuna is currently subject to overfishing but not overfished, while the stocks of yellowfin tuna and skipjack tuna in the WCPO are neither experiencing overfishing nor overfished. The management measures for the Hawaii-based deep-set and shallow-set longline fisheries would implement catch limits for bigeye tuna and yellowfin tuna for the years 2015-2020. Thus, it is conceivable that the indirect effects (or long-term effects), of this alternative on the fleet would be negative, in that the No-Action Alternative would be less likely to achieve the objectives of the proposed action, which in turn would be expected to adversely affect the catch rates of the Hawaii-based deep-set and shallow-set longline fisheries to maintain catch levels and the profitability of fishing businesses. However, as discussed in Section 3.5 of this PEA, many other factors affect the stock status of bigeye tuna, yellowfin tuna, and skipjack tuna in the WCPO (fishing activities by non-U.S. fleets, oceanographic conditions, etc.).

4.2.2 **Alternative B, Least Restrictive Action Alternative**

Under this alternative, the management measures that would affect the Hawaii-based deep-set and shallow-set longline fisheries are a longline bigeye tuna catch limit of 3,554 mt in 2015 and 5,000 mt in each of the calendar years 2016-2020 in the Convention Area and a longline yellowfin tuna catch limit of 1,142 mt in each of the calendar years 2015-2020 in the Convention Area. NMFS could implement the catch limits in one of the following ways: (1) closing the deep-set fishery once one of the catch limits is reached; (2) closing both the deep-set and shallow-set fisheries once one of the catch limits is reached; or (3) prohibiting the retention, landing, or transshipping of bigeye tuna and yellowfin tuna, respectively, when each of the catch limits are reached. Each of these options is discussed in the sections that follow.

4.2.2.1 Alternative B, Option 1: Closure of the Deep-Set Fishery

If the deep-set fishery is closed once one of the catch limits is reached in a given calendar year, it would be prohibited to use a U.S. fishing vessel to deploy longline gear in the Convention Area, to retain on board bigeye tuna or yellowfin tuna captured by longline gear in the Convention Area, or to land or transship bigeye tuna or yellowfin tuna captured by longline gear in the Convention Area. Exempt from the prohibitions would be the use of a vessel to deploy longline gear in a shallow-set manner to target swordfish. Also, any bigeye tuna or yellowfin tuna on board at the time of the closure may be retained on board and landed. If a vessel's catch is attributed to the longline fishery of one of the U.S. territories participating in the WCPFC (American Samoa, Guam, or the CNMI, collectively U.S. Participating Territories), the vessel could continue to fish using deep-set longline gear and land bigeye tuna and yellowfin tuna. The criteria for catch attribution to one of the Participating Territitories includes: (1) the fish is landed in one of the U.S. Participating Territories, provided that it was not caught in the portion of the U.S. EEZ other than the portion of the U.S. EEZ surrounding the territory in which it was landed and is landed by a U.S. fishing vessel operated in compliance with a valid permit issued under the Pelagics FEP or West Coast HMS FMP; (2) the fish is caught by a vessel registered for use under a valid American Samoa Longline Limit Access Permit, not caught in the portion of the U.S. EEZ other than the portion of the U.S. EEZ surrounding American Samoa, and is landed by a U.S. fishing vessel operated in compliance with a valid permit issued under the Pelagics FEP or West Coast HMS FMP; or (3) the fish is caught by a vessel that is included in a specified fishing agreement under 50 CFR 665.819(c) and can be attributed in accordance with the specified fishing agreement to one of the Participating Territories, subject to applicable regulations for such specified fishing agreements.

The closure of the deep-set fishery could cause changes to the fishing patterns and practices of the vessels in the Hawaii longline fisheries. If and when the maximum allowable amount of bigeye tuna or yellowfin tuna retained catch is reached in a given year, affected fishing businesses would be expected to cease fishing for the remainder of the calendar year or to shift from deep-setting in the WCPO to the next best opportunity. Although those opportunities cannot be predicted with certainty, two opportunities that would appear to be attractive to vessels in the fisheries include shallow-setting (i.e., for swordfish) and deep-setting for bigeye tuna or yellowfin tuna in other areas, specifically the EPO. Making such shifts would bring opportunity

costs to the affected fishing operations, but the magnitude of those costs cannot be projected. NMFS has implemented the longline bigeye tuna catch limit in the IATTC's Resolution C-13-01, "Resolution on a Multiannual Program for the Conservation of Tuna in the Eastern Pacific Ocean in 2014-2016." This catch limit is set at 500 mt for U.S. longline vessels over 24 meters in overall length operating in the EPO (i.e., the IATTC's area of competence), so larger vessels fishing in the EPO during the period of time the prohibitions are in effect would be subject to that limit in 2015 and 2016.

Because the limits would be set on a calendar year basis, the "race to fish" effect would be expected at the beginning of the calendar year, and the closure of the deep-set sector of the fishery would be expected toward the end of the calendar year, based on catch levels in recent year, as set forth in Table 8 and Table 9. A race to fish could cause vessel operators to forego vessel maintenance or to fish in weather or ocean conditions than they otherwise would not, which could affect human safety and the performance of the vessel and the fishing gear and its crew. This race to fish effect could also be expected in the time period between when closure of deep-setting is announced and when the closure takes place. The degree of the race to fish effect cannot be predicted with certainty. However, given that fishing effort and catch is dependent on many other factors (e.g., ocean conditions and market conditions), it is unlikely that any adverse effects would be substantial.

Vessels operating as part of the fisheries of the U.S. Participating Territories under the criteria specified above after the catch limits are reached, would be unaffected by the catch limits. Depending on the number of vessels that operate as part of the fisheries of the U.S. Participating Territories after the catch limits are reached, the effects on fishing patterns and practices from this option could be similar, if not identical to, the No-Action Alternative (e.g., if all vessels operate as part of the fisheries of the U.S. Participating Territories after the catch limits are reached).

4.2.2.2 Alternative B, Option 2: Closure of Both the Deep-Set and Shallow-Set Fisheries

If both the deep-set and shallow-set fisheries are closed once a catch limit is reached in a given calendar year, no U.S. vessels would be allowed to conduct longline fishing operations in the Convention Area, except that any bigeye tuna or yellowfin tuna already on board a vessel at the time of the closure may be retained on board and landed. If a vessel's catch is attributed to the longline fishery of one of the U.S. Participating Territories, using the criteria specified above, the vessel could continue to fish using longline gear and land bigeye and yellowfin tuna.

The closure of the fisheries could cause changes to the fishing patterns and practices of the vessels in the Hawaii longline fisheries. If and when the maximum allowable amount of bigeye tuna or yellowfin tuna retained catch is reached in a given year, affected fishing businesses would be expected to cease fishing for the remainder of the calendar year or to shift to the next best opportunity. Although those opportunities cannot be predicted with certainty, one opportunity that would appear to be attractive to vessels in the fisheries is deep-setting for bigeye tuna or yellowfin tuna in other areas, specifically the EPO. Making such a shift would bring opportunity costs to the affected fishing operations, but the magnitude of those costs cannot be

projected. NMFS has implemented the longline bigeye tuna catch limit in the IATTC's Resolution C-13-01, "Resolution on a Multiannual Program for the Conservation of Tuna in the Eastern Pacific Ocean in 2014-2016." This catch limit is set at 500 mt for U.S. longline vessels over 24 meters in overall length operating in the EPO (i.e., the IATTC's area of competence), so larger vessels fishing in the EPO during the period of time the prohibitions are in effect would be subject to that limit in 2015 and 2016.

Because the limits would be set on a calendar year basis, the "race to fish" effect would be expected at the beginning of the calendar year, and the closure of the deep-set sector of the fishery would be expected toward the end of the calendar year. A race to fish could cause vessel operators to forego vessel maintenance or to fish in weather or ocean conditions than they otherwise would not, which could affect human safety and the performance of the vessel and the fishing gear and its crew. This race to fish effect could also be expected in the time period between when closure of deep-setting is announced and when the closure takes place. The degree of the race to fish effect cannot be predicted with certainty. However, given that fishing effort and catch is dependent on many other factors (e.g., ocean conditions and market conditions), it is unlikely that any adverse effects would be substantial.

Vessels operating as part of the fisheries of the U.S. Participating Territories under the criteria specified above after the catch limits are reached, would be unaffected by the catch limits. Depending on the number of vessels that operate as part of the fisheries of the Participating Territories after the catch limits are reached, the effects on fishing patterns and practices from this option could be similar, if not identical to, the No-Action Alternative (e.g., if all vessels operate as part of the fisheries of the U.S. Participating Territories after the catch limits are reached).

4.2.2.3 Alternative B, Option 3: Prohibition on Retention, Landing, or Transshipping of Bigeye Tuna or Yellowfin Tuna

If NMFS prohibits the retention on board, landing, or transshipment of bigeye tuna when the bigeye tuna catch limit is reached and the retention on board, landing, or transshipment of yellowfin tuna when the yellowfin tuna catch limit is reached, the fisheries would not be closed. However, no bigeye tuna could be retained on board once the bigeye tuna catch limit is reached and no yellowfin tuna could be retained on board once the yellowfin tuna catch limit is reached, except that any bigeye tuna or yellowfin tuna already on board a vessel at the time of the closure may be retained on board and landed. If a vessel's catch is attributed to the longline fishery of one of the U.S. Participating Territories, using the criteria specified above, the vessel could continue to fish for and land bigeye and yellowfin tuna.

This option would be expected to cause changes to the fishing patterns and practices of the Hawaii-based longline fisheries. If and when the maximum allowable amount of bigeye tuna or yellowfin tuna retained catch is reached in a given year, affected fishing businesses would be expected to cease fishing for the remainder of the calendar year or shift from deep-setting for bigeye tuna and yellowfin tuna in the WCPO to the next best opportunity. Although those opportunities cannot be predicted with certainty, three opportunities that would appear to be attractive to vessels in the fishery include shallow-setting (i.e., for swordfish), deep-setting for

bigeye tuna and yellowfin tuna in other areas, specifically the EPO, and deep-set longline fishing in the Convention Area for species other than bigeye tuna and yellowfin tuna. Making such shifts would bring opportunity costs to the affected fishing operations, but the magnitude of those costs cannot be projected. It is not known whether deep-setting for species other than bigeye tuna and yellowfin tuna in the Convention Area would be economically viable. Given the lack of this kind of fishing activity historically, it would appear to be more costly than shallow-setting or deep-setting for bigeye tuna and yellowfin tuna in the EPO.

Because the limit would be set on a calendar year basis, the "race to fish" effect would be expected at the beginning of the calendar year, and the prohibitions would be expected to go into effect at the end of the calendar year. This race to fish effect could also be expected in the time period between when announcement of the prohibition is made and when the prohibition takes place. The degree of the race to fish effect cannot be predicted with certainty. However, given that fishing effort and catch is dependent on many other factors (e.g., ocean conditions and market conditions), it is unlikely that any adverse effects would be substantial.

Vessels operating as part of the fisheries of the U.S. Participating Territories under the criteria specified above after the catch limits are reached, would be unaffected by the catch limits. Depending on the number of vessels that operate as part of the fisheries of the Participating Territories after the catch limits are reached, the effects on fishing patterns and practices from this option could be similar, if not identical to, the No-Action Alternative (e.g., if all vessels operate as part of the fisheries of the U.S. Participating Territories after the catch limits are reached).

4.2.3 **Alternative C, Most Restrictive Action Alternative**

Under this alternative, the management measures that would affect the Hawaii-based deep-set and shallow-set longline fisheries are a longline bigeye tuna catch limit of 2,090 mt in each of the calendar years 2015-2020 in the Convention Area and a longline yellowfin tuna catch limit of 421 mt in each of the calendar years 2015-2020 in the Convention Area. NMFS could implement the catch limits in one of the following ways: (1) closing the deep-set fishery once one of the catch limits is reached; (2) closing both the deep-set and shallow-set fisheries once one of the catch limits is reached; or (3) prohibiting the retention, landing, or transshipping of bigeye tuna and yellowfin tuna, respectively, when each of the catch limits are reached. Each option would have the same effects on the fisheries as those discussed for Alternative B, above. However, given that the amount of the catch limits would be substantially less than catch levels in recent years (see Table 8 and Table 9), it is likely that the limits would be reached much earlier in the year, though difficult to predict exactly when the limits would be reached, given variability of catch from year to year.

4.2.4 **Alternative D and Alternative H**

Alternative D and Alternative H are variations to elements of Alternative C that are applicable to the U.S. WCPO purse seine fleet. Thus, Alternative D and Alternative H would be identical to Alternative C in terms of effects on the fishing patterns and practices of the Hawaii-based deep-set and shallow-set longline fisheries.

4.2.5 **Alternative E, Alternative F, Alternative G, Alternative I, and Alternative J**

Alternative E, Alternative F, Alternative G, Alternative I, and Alternative J are variations to elements of Alternative B that are applicable to the U.S. WCPO purse seine fleet. Thus, these alternatives would be identical to Alternative B in terms of effects on the fishing patterns and practices of the Hawaii-based deep-set and shallow-set longline fisheries.

4.2.6 **Alternative K, Multiyear Limits**

This alternative would be the same as Alternative B for the Hawaii-based longline fisheries, except the longline bigeye tuna catch limit and the longline yellowfin tuna catch limit would be applied on a multiyear basis. Rather than being calendar year annual limits, all of these limits would be applied to three-year periods. This alternative would allow for more operational flexibility for the fisheries. As indicated in Table 8 and Table 9, the catch in the fisheries varies from year to year and is dependent on oceanographic and economic factors. With multiyear catch limits, the vessels in the fisheries could take advantage of this variability and fish more in one year and less in another year without exceeding a specific calendar year limit. Thus, it is less likely that the effort and catch limits would be reached under this alternative than under Alternative B.

4.3 ***Longline fisheries of the U.S. Participating Territories***

As described in Chapter 3, the U.S. longline fisheries in the Convention Area include an American-Samoa based fishery that targets primarily albacore and some limited longlining activity in the Mariana Islands longine fishery. As explained above, because vessels operating as part of the longline fisheries of the U.S. Participating Territories would not be subject to the longline bigeye tuna catch limits or prohibitions that go into effect when the catch limits are reached, the fishing patterns and practices in the longline fisheries of the U.S. Participating Territories would not be expected to be affected by any of the action alternatives.

4.4 ***Physical Environment and Climate Change***

None of the alternatives (No-Action Alternative or any of the action alternatives) would be expected to cause direct or indirect effects to the physical environment of the WCPO. In addition, none of the alternatives would be expected to contribute to climate change. Under the action alternatives, implementation of the purse seine fishing effort limits, FAD setting restrictions, purse seine bigeye and yellowfin tuna catch limits, and longline bigeye and yellowfin tuna catch limits could marginally increase fuel use, if vessels in the fleet steam to locations farther than they otherwise would due to any fishery closure or restriction that leads vessels to seek opportunities in locations than they otherwise would. However, the purse seine fishing effort limits and the purse seine and longline bigeye and yellowfin tuna catch limits could also cause an overall decrease in fuel use if there is an overall decrease in fishing effort by the

fleets. Moreover, given that the catch and effort of the fleets vary substantially from year to year, as shown in Table 2, Table 3, Table 8, and Table 9 in Chapter 3 of this EA, the overall fuel use of the fleet would be expected to depend more on other factors (fuel price, market conditions, oceanographic changes affecting the location of the target tunas, etc.), and the action alternatives would not be expected to lead to increased emissions of greenhouse gases affecting climate change.

4.5 *Bigeye Tuna, Skipjack Tuna, and Yellowfin Tuna*

This section presents the analysis of the potential impacts that could be caused by the No-Action Alternative and each of the action alternatives analyzed in depth in this PEA to bigeye tuna, skipjack tuna, and yellowfin tuna in the WCPO – the three stocks on which CMM 2014-01 focuses.

4.5.1 **Alternative A, the No-Action Alternative**

Under Alternative A, the management measures in the action alternatives for the U.S. purse seine and longline fisheries in the Convention Area would not be implemented. Thus, there would be no direct changes to the fishing patterns of the fleet and no resulting direct effects to bigeye tuna, yellowfin tuna, or skipjack tuna.

As shown in Table 11 of this EA, the stock of bigeye tuna in the Pacific is experiencing overfishing but the stocks of skipjack tuna and yellowfin tuna in the WCPO and EPO are neither experiencing overfishing nor are they overfished. As stated in Chapter 1, the underlying objectives of the WCPFC's management of tropical tunas in the WCPO, as set forth in CMM 2014-01, included specific objectives for the stocks of bigeye tuna, skipjack tuna, and yellowfin tuna: for each, the fishing mortality rate is to be reduced to or maintained at levels no greater than the fishing mortality rate associated with maximum sustainable yield, and as reflected in the Commission's limit reference points for these stocks, are to avoid the spawning stocks becoming smaller than 20 percent of the estimated spawning stock size in the absence of fishing. Because Alternative A would not implement the management measures for purse seine and longline fisheries, the objectives of the WCPFC for management of tropical tunas in 2015-2020 would be less likely to be met under this alternative than under any of the action alternatives. It is conceivable that the indirect effects (or long-term effects) of this alternative on bigeye tuna, yellowfin tuna, and skipjack tuna would be increased fishing pressure on stocks relative to the action alternatives, leading to a decline to sizes smaller than that which is capable of producing maximum sustainable yield.

On the other hand, as stated in Chapter 3, many other factors affect the status of these stocks. Thus, it is likely that the status of the stocks under the No-Action Alternative would not differ substantially from the status of the stocks under any of the action alternatives. Under this alternative, however, any minor beneficial effects that the stocks could experience from implementation of the action alternatives would not occur. Thus, there could be some marginal increased potential for long-term negative effects to the stocks over the action alternatives, although such effects cannot be predicted or estimated with certainty at this time.

4.5.2 **Alternative B, Least Restrictive Action Alternative**

As stated in Section 4.1.2 above, Alternative B would be unlikely to substantially affect the fishing patterns and practices of the U.S. WCPO purse seine fleet. Should the fishing effort limit in the ELAPS be reached in any of the years 2015-2020, the fleet could fish more in the EEZs of Pacific Island Parties to the SPTT or in the EPO and could cause a reduction in the total fishing effort of the fleet, but it is unlikely that the limit would be reached under this alternative. The three month FAD setting prohibition period for each calendar year would likely lead to the transfer of some fishing effort from FAD sets to unassociated sets, with consequent impacts in terms of species composition of the catch. The yellowfin tuna catch limit could lead to a closure of the fishery once the catch limit is reached, but it unlikely that the catch limit would be reached under this alternative.

As stated in Section 4.2.2 above, under Alternative B, the Hawaii-based longline fisheries could be affected when the longline bigeye tuna or yellowfin tuna catch limit is reached in a given year. The degree of the effects would depend on which option NMFS uses to implement the catch limit (closure of deep-set fishery, closure of both deep-set and shallow-set fishery, or prohibition on retention, transshipment, and landing) and how many vessels operate as part of the fisheries of one of the U.S. Participating Territories after the limit is reached.

Should there be a reduction in overall fishing effort by the U.S. WCPO purse seine fleet and the vessels in the Hawaii-based longline fisheries under this alternative, there could be resulting effects on the stocks of bigeye tuna, yellowfin tuna, and skipjack tuna, which include direct beneficial impacts by reducing fishing mortality on the stocks over the No-Action Alternative, and indirect beneficial effects if the decreased fishing mortality leads to long-term positive effects on the stocks. The FAD setting prohibition period for the purse seine fleet could also lead to some beneficial direct and indirect effects on the stocks by reducing fishing mortality on bigeye tuna and also perhaps smaller yellowfin and skipjack tuna during the prohibition period. Although the fleet could target large unassociated yellowfin tunas during the prohibition period, any potential increased catch of larger yellowfin tuna would be ameliorated by reduced catches of smaller yellowfin tuna during the prohibition period, which may have a chance to move or recruit to a to a deeper, non-predominantly FAD associated life cycle that would provide benefits in terms of additional larger yellowfin tuna available to unassociated fishing. Indeed, as indicated by the recent study conducted in 2014, unassociated sets yield slightly better stock status for yellowfin tuna, in terms of higher spawning biomass and lower fishing mortality, than associated sets (Hampton and Pilling 2014). The effects of the FAD setting prohibition period on skipjack tuna are unknown.

Overall, because the fishing patterns and practices of fleets would not change substantially under Alternative B from the No-Action Alternative, and, as described in Chapter 3, because many other factors contribute to the status of the stocks (fishing activities by non-U.S. fleets, oceanographic conditions, etc.), the direct and indirect effects to bigeye, yellowfin, and skipjack tuna from implementation of Alternative B would be expected to be small.

As discussed in Chapter 3, adult bigeye tuna, skipjack tuna, and yellowfin tuna are considered among the top predators of the tropical or warm pool marine ecosystem. Changes to the stocks of these species could lead to trophic interactive effects, including increased competition for prey species with other top predators. Larval and juvenile tunas are also a significant source of food for other marine species, such as fish, seabirds, porpoises, marine mammals, and sharks. Thus, increases in larval and juvenile tuna could increase the food available for these other species. It is unlikely that the effects of Alternative B to the stocks of bigeye, skipjack and yellowfin tuna would be large enough to impact the marine ecosystem. Overall, Alternative B would not be expected to cause substantial effects on biodiversity and ecosystem function.

4.5.3 Alternative C, Most Restrictive Action Alternative

As stated above, under Alternative C, the fishing patterns and practices of the U.S. WCPO purse seine fleet would be substantially affected. The purse seine effort limit of 432 fishing days on the high seas and 25 fishing days in the U.S. EEZ would be likely to be reached in each of the calendar years 2015 and 2020, which could either reduce overall purse seine fishing effort or shift effort to PIC EEZs or the EPO. The six-month total fishery closure could substantially reduce purse seine fishing effort in the Convention Area, which could lead to vessel owners and operators leaving the fishery and seeking other opportunities. If the FAD set limit is reached in any of the calendar years, fishing effort could be transferred to unassociated sets, with resulting consequences on the composition of the catch – perhaps more larger yellowfin and skipjack tuna and likely less bigeye tuna. The high seas FAD setting prohibition period in each of the calendar years 2017-2020 could also transfer effort to unassociated sets on the high seas or to FAD sets in the U.S. EEZ or in PIC EEZs. It is likely that the yellowfin tuna catch limit would be reached, which would likely result in a closure of the fishery. A rough approximation is that the yellowfin tuna catch limit would be reached after the fleet fishes for four months of a calendar year. Thus, overall it is likely that under Alternative C, the U.S. WCPO purse seine fleet would be able to fish in the Convention Area for roughly four months each calendar year, and could be subject to FAD setting restrictions in some of those months each year (due to the FAD set limit and the prohibition on fishing on FADs on the high seas in 2017-2020), and would fish more in PIC EEZs than elsewhere, due to the fishing day effort limits in the U.S. EEZ and on the high seas.

For the Hawaii-based longline fisheries, it is likely that the bigeye and yellowfin tuna catch limits would be reached much earlier in the year than under Alternative B. The degree of the effects on the fishing patterns and practices of the vessels in the fisheries would depend on which option NMFS uses to implement the catch limit (closure of deep-set fishery, closure of both deep-set and shallow-set fishery, or prohibition on retention, transshipment, and landing) and how many vessels operate as part of the fisheries of one of the U.S. Participating Territories after the limit is reached.

Fishing effort would likely be substantially reduced for the U.S. WCPO purse seine fleet and likely at least somewhat reduced for the Hawaii-based longline fisheries under this alternative. Thus, there could be resulting effects on the stocks of bigeye tuna, yellowfin tuna, and skipjack tuna, which include direct beneficial impacts by reducing fishing mortality on the stocks over the No-Action Alternative, and indirect beneficial effects if the decreased fishing mortality leads to

long-term positive effects on the stocks. The FAD set limit and high seas FAD setting prohibition period in 2017-2020 for the purse seine fleet could also lead to some beneficial direct and indirect effects on the stocks by reducing fishing mortality on bigeye tuna and perhaps also smaller yellowfin tuna and skipjack tuna during any period prohibitions on FAD fishing would be in effect. Although the fleet could target more large unassociated yellowfin tunas during the prohibition periods, any potential increased catch of larger yellowfin tuna would be ameliorated by reduced catches of smaller yellowfin tuna during the prohibition period, which may have a chance to move or recruit to a deeper, non-predominantly FAD associated life cycle that would provide benefits in terms of additional adult yellowfin tuna available to unassociated fishing. Indeed, as indicated by the recent study conducted in 2014, unassociated sets yield slightly better stock status for yellowfin tuna, in terms of higher spawning biomass and lower fishing mortality, than associated sets (Hampton and Pilling 2014). The effects of the FAD setting prohition periods on skipjack tuna are unknown.

However, although the fishing patterns and practices of the U.S. WCPO purse seine fleet would be expected to change substantially under Alternative C from the No-Action Alternative and the fishing patterns and practices of the Hawaii-based fleet would be expected to change somewhat as well, because many other factors contribute to the status of the stocks (fishing activities by non-U.S. fleets, oceanographic conditions, etc.), the direct and indirect effects to bigeye, yellowfin, and skipjack tuna from implementation of Alternative C would not be expected to be substantial. The effects would be expected to be greater than under Alternative B, but unlikely to lead to substantial effects on the stocks of bigeye, yellowfin, and skipjack tuna in the WCPO. Moreover, should vessel owners and operators leave the U.S. WCPO purse seine fishery and reflag to another country with a purse seine fleet operating in the WCPO, the beneficial effects caused by the reduction in fishing effort could be counteracted.

As discussed in Chapter 3, adult bigeye tuna, skipjack tuna, and yellowfin tuna are considered among the top predators of the tropical or warm pool marine ecosystem. Changes to the stocks of these species could lead to trophic interactive effects, including increased competition for prey species with other top predators. Larval and juvenile tunas are also a significant source of food for other marine species, such as fish, seabirds, porpoises, marine mammals, and sharks. Thus, increases in larval and juvenile tuna could increase the food available for these other species. Although the effects to the stocks would be greater under Alternative C than under Alternative B, it is unlikely that the effects of Alternative C to the stocks of bigeye, skipjack and yellowfin tuna would be large enough to impact the marine ecosystem. Overall, Alternative C would not be expected to cause substantial effects on biodiversity and ecosystem function.

4.5.4 **Alternative D, Most Restrictive FAD Setting Prohibition Period Variation**

This alternative would be the same as Alternative C, except that instead of a total prohibition on U.S. purse seine fishing for six months and a FAD set limit, there would be a purse seine FAD setting prohibition period for the full year each year. Thus, the effects to bigeye, yellowfin, and skipjack tuna under this alternative would be very similar to the effects described above under Alternative C. Should the purse seine yellowfin tuna catch limit be implemented via a fishery closure, then Alternative D would likely have increased potential for beneficial effects to the

stocks of bigeye, yellowfin, and skipjack tuna over Alternative C, since the prohibitions on fishing on FADs specified in Section 4.1.2.2 would be in place throughout the Convention Area for the entire time period during which the fishery would be open, not just if the FAD set limit is reached and on the high seas during 2017-2020, as under Alternative C. Should the purse seine yellowfin tuna catch limit not be implemented via a fishery closure, then Alternative D would have less potential for beneficial effects to the stocks of bigeye, yellowfin, and skipjack tuna over Alternative C, since the U.S. WCPO purse seine fishery would remain open for the full year, so fishing effort in the Convention Area would not be expected to be reduced as much as it would be under Alternative C.

For the reasons discussed above in Section 4.5.3 for Alternative C, Alternative D would not be expected to cause substantial effects on biodiversity and ecosystem function.

4.5.5 **Alternative E, Additional FAD Setting Prohibition Period**

Alternative E would be the same as Alternative B, except that instead of a three month FAD setting prohibition period for the U.S. WCPO purse seine fleet, there would be a four month FAD setting prohibition period each year. So, there would be an additional month during which there would be transfer of purse seine fishing from FAD sets to unassociated sets, with resulting consequences on the composition of the catch – perhaps more larger yellowfin and skipjack tuna and likely less bigeye tuna. Thus, Alternative E could lead to the potential for slightly more beneficial effects on bigeye, yellowfin, and skipjack tuna than under Alternative B, by reducing fishing mortality on bigeye tuna and perhaps smaller skipjack and yellowfin tuna during the prohibition period. As for Alternative B, although the fleet could target more large unassociated yellowfin tunas during the prohibition period, any potential increased catch of larger yellowfin tuna would be ameliorated by reduced catches of smaller yellowfin tuna during the prohibition period, which may have a chance to move or recruit to a to a deeper, non-predominantly FAD associated life cycle that would provide benefits in terms of additional adult yellowfin tuna available to unassociated fishing. Indeed, as indicated by the recent study conducted in 2014, unassociated sets yield slightly better stock status for yellowfin tuna, in terms of higher spawning biomass and lower fishing mortality, than associated sets (Hampton and Pilling 2014). The effects of the FAD prohibition period on skipjack tuna are unknown.

Overall, similar to Alternative B, because the fishing patterns and practices of fleets would not change substantially under Alternative E from the No-Action Alternative, and, as described in Chapter 3, because many other factors contribute to the status of the stocks (fishing activities by non-U.S. fleets, oceanographic conditions, etc.), the direct and indirect effects to bigeye, yellowfin, and skipjack tuna from implementation of Alternative E would be expected to be small.

For the reasons discussed above in Section 4.5.2 for Alternative B, Alternative E would not be expected to cause substantial effects on biodiversity and ecosystem function.

4.5.6 **Alternative F, FAD Set Limit Variation**

Alternative F would be the same as Alternative B, except that there would be a FAD set limit of 2,522 sets for the U.S. WCPO purse seine fleet. Based on fishing patterns and practices of the U.S. WCPO purse seine fleet in recent years, the FAD set limit may or may not be reached in a given calendar year. It is possible that the FAD set limit could be reached as early as May or June in a given calendar year. If the FAD set limit is not reached under Alternative F, the effects of this alternative to bigeye, yellowfin, and skipjack tuna would be identical to those under Alternative B. Should the FAD set limit be reached, Alternative F could lead to lead to the potential for slightly more beneficial effects on bigeye, yellowfin, and skipjack tuna than under Alternative B, by reducing fishing mortality on bigeye tuna and perhaps smaller skipjack and yellowfin tuna during a longer FAD setting prohibition period. As for Alternative B, although the fleet could target more large unassociated yellowfin tunas during the prohibition period, any potential increased catch of larger yellowfin tuna would be ameliorated by reduced catches of smaller yellowfin tuna during the prohibition period, which may have a chance to move or recruit to a to a deeper, non-predominantly FAD associated life cycle that would provide benefits in terms of additional larger yellowfin tuna available to unassociated fishing. Indeed, as indicated by the recent study conducted in 2014, unassociated sets yield slightly better stock status for yellowfin tuna, in terms of higher spawning biomass and lower fishing mortality, than associated sets (Hampton and Pilling 2014). The effects of the FAD prohibition period on skipjack tuna are unknown.

Overall, similar to Alternative B, because the fishing patterns and practices of fleets would not change substantially under Alternative E from the No-Action Alternative, and, as described in Chapter 3, because many other factors contribute to the status of the stocks (fishing activities by non-U.S. fleets, oceanographic conditions, etc.), the direct and indirect effects to bigeye, yellowfin, and skipjack tuna from implementation of Alternative F would be expected to be small.

For the reasons discussed above in Section 4.5.2 for Alternative B, Alternative E would not be expected to cause substantial effects on biodiversity and ecosystem function.

4.5.7 **Alternative G, Total Purse Seine Closure Variation**

Alternative G would be the same as Alternative B, except that there would be a three month total closure of the U.S. WCPO purse seine fishery in the Convention Area rather than a three month FAD setting prohibition period. Thus, Alternative G would lead to a greater potential reduction in fishing effort than Alternative B and could even lead vessel owners and operators to leave the fishery and seek other opportunities. The greater potential reduction in fishing effort could lead to the potential for increased beneficial effects to bigeye, yellowfin, and skipjack tuna. However, should vessel owners and operators leave the U.S. WCPO purse seine fishery and reflag to another country with a purse seine fleet operating in the WCPO, the beneficial effects caused by the reduction in fishing effort could be counteracted.

The effects on fishing patterns and practices of the fleet from the remaining elements of Alternative G would be identical to those under Alternative B. However, should the three-month closure period overlap with the three-month FAD setting prohibition period, then the transfer of fishing effort to unassociated sets during the FAD setting prohibition period would not be expected to occur, and the potential beneficial effects to the stocks during the FAD setting prohibition period that could take place under Alternative B would not occur.

Although the fishing patterns and practices of the U.S. WCPO purse seine fleet would be expected to change substantially under Alternative G from the No-Action Alternative, because many other factors contribute to the status of the stocks (fishing activities by non-U.S. fleets, oceanographic conditions, etc.), the direct and indirect effects to bigeye, yellowfin, and skipjack tuna from implementation of Alternative G would not be expected to be substantial – somewhere in between the effects caused by Alternative B and Alternative C. Moreover, should vessel owners and operators leave the U.S. WCPO purse seine fishery and reflag to another country with a purse seine fleet operating in the WCPO, the beneficial effects caused by the reduction in fishing effort could be counteracted.

4.5.8 **Alternative H, Most Restrictive Without High Seas FAD Closure**

This alternative would be the same as Alternative C, except that there would be no prohibition on fishing on FADs on the high seas for U.S. purse seine vessels in 2017 through 2020. Thus the potential effects to bigeye, yellowfin, and skipjack tuna would be the same as under Alternative C, but there would be a slightly reduced potential for beneficial effects on the stocks, since there could be more fishing on FADs than under Alternative C.

4.5.9 **Alternative I, Variation on Purse Seine Fishing Effort Limits**

Under Alternative I, there would a smaller fishing effort limit in the ELAPS for the U.S. WCPO purse seine fleet than under Alternative B, and all of the other elements of the alternative would be the same as under Alternative B. Thus, under this alternative, it would be more likely that the ELAPS limit would be reached and would be closed to purse seine fishing for a portion of a given calendar year than under Alternative B. Should such an ELAPS closure lead to a reduction in overall fishing effort by the purse seine fleet, there could be a potential for increased beneficial effects to the stocks of bigeye tuna, yellowfin tuna and skipjack tuna over Alternative B.

Overall, similar to Alternative B, because the fishing patterns and practices of fleets would not be expected to change substantially under Alternative I from the No-Action Alternative, and, as described in Chapter 3, because many other factors contribute to the status of the stocks (fishing activities by non-U.S. fleets, oceanographic conditions, etc.), the direct and indirect effects to bigeye, yellowfin, and skipjack tuna from implementation of Alternative I would be expected to be small.

For the reasons discussed above in Section 4.5.2 for Alternative B, Alternative I would not be expected to cause substantial effects on biodiversity and ecosystem function.

4.5.10 **Alternative J, Variation on Purse Seine Fishing Effort Limits, Separate Areas**

Alternative J would be the same as Alternative I, but there would be separate fishing effort limits for the U.S. EEZ and for the high seas for the U.S. WCPO purse seine fleet. The sum total of the available fishing days in these areas would be equal to the ELAPS limit under Alternative I. Under this alternative, it is likely that limits in the U.S. EEZ and on the high seas would be reached at different times. Based on available data, it is likely that the high seas would be closed for a longer period of time in 2015 than would the U.S. EEZ, and likely that the limit in the U.S. EEZ would not be reached in 2015; similar circumstances could arise in 2016-2020. Thus, Alternative J could lead to the slightly more beneficial effects on the stocks of bigeye, yellowfin, and skipjack tuna than Alternative I, if fishing effort is more constrained under this alternative.

Overall, similar to Alternative B, because the fishing patterns and practices of fleets would not be expected to change substantially under Alternative J from the No-Action Alternative, and, as described in Chapter 3, because many other factors contribute to the status of the stocks (fishing activities by non-U.S. fleets, oceanographic conditions, etc.), the direct and indirect effects to bigeye, yellowfin, and skipjack tuna from implementation of Alternative J would be expected to be small.

For the reasons discussed above in Section 4.5.2 for Alternative B, Alternative J would not be expected to cause substantial effects on biodiversity and ecosystem function.

4.5.11 **Alternative K, Multiyear Limits**

Alternative K would be the same as Alternative B, except that the purse seine fishing effort limit in the ELAPS, and the bigeye and yellowfin tuna catch limits for the purse seine fleet and the Hawaii-based longline fleet would be implemented for three-year periods rather than for calendar year periods. This alternative would provide some operational flexibility for the fleets, and would take into consideration annual variations in fishing catch and effort by the fleets, due to variations in oceanographic and economic conditions. Thus, it is less likely that the effort and catch limits would be reached under this alternative than under Alternative B. Accordingly, there would be a reduced potential for beneficial effects to the stocks of bigeye, yellowfin, and skipjack tuna than under Alternative B.

Overall, similar to Alternative B, because the fishing patterns and practices of fleets would not be expected to change substantially under Alternative K from the No-Action Alternative, and, as described in Chapter 3, because many other factors contribute to the status of the stocks (fishing activities by non-U.S. fleets, oceanographic conditions, etc.), the direct and indirect effects to bigeye, yellowfin, and skipjack tuna from implementation of Alternative K would be expected to be small.

For the reasons discussed above in Section 4.5.2 for Alternative B, Alternative K would not be expected to cause substantial effects on biodiversity and ecosystem function.

4.6 *Other Target Fish Species*

This section presents the analysis of the potential impacts that could be caused by the No-Action Alternative and each of the action alternatives analyzed in depth in this PEA to other target fish species by U.S. purse seine or longline fleets fishing in the Convention Area. These species include albacore and swordfish.

4.6.1 **Alternative A, No-Action Alternative**

Under Alternative A, the No-Action Alternative, the management measures in the action alternatives for the U.S. purse seine and longline fisheries in the Convention Area would not be implemented. Thus, there would be no direct changes to the fishing patterns of the fleet and no resulting direct effects to albacore and swordfish. As discussed above in Section 4.5.1, it is conceivable that the indirect, or long-term, effects of the No-Action Alternative on bigeye tuna, skipjack tuna, and yellowfin tuna would be negative, should this alternative lead to increased fishing pressure on the stocks, relative to the action alternatives. Any such increased fishing pressure could conceivably also lead to long-term negative effects on swordfish, as it is targeted by the Hawaii-based shallow-set fishery. However, implementation of the longline bigeye or yellowfin catch limits under the action alternatives could also lead to increased fishing pressure on swordfish, if the Hawaii-based longline fleet is allowed to continue fishing for swordfish in the Convention Area after the catch limits are reached. So, the No-Action Alternative would not be expected to have increased potential for negative effects on swordfish over the action alternatives. Of the U.S. longline and purse seine fleets operating in the WCPO, albacore is targeted by the American Samoa-based longline fishery, which would not be affected by the action alternatives, so it is not expected to experience any indirect effects under the No-Action Alternative. Overall, given that many other factors influence the status of non-target fish species (e.g., fisheries that target those species, oceanic conditions), it is unlikely that there would be any indirect effects to non-target species under the No-Action Alternative, stemming from lack of implementation of any of the action alternatives.

4.6.2 **Action Alternatives**

Under Alternatives B, C, D, E, F, G, H, I, J, K, no substantial effects would be expected on albacore, as it is targeted by the American Samoa-based longline fleet, which would not be affected by the action alternatives, only retained in relatively small proportions to total retained catch of by the Hawaii-based longline fleet (see Table 8 and Table 9), and generally not caught by the U.S. WCPO purse seine fleet (see Table 12). So the changes in fishing patterns and practices under the action alternatives would not be expected to lead to substantial direct or indirect effects on albacore.

Similarly, under Alternatives B, C, D, E, F, G, H, I, J, and K, the changes in fishing patterns and practices to the Hawaii-based longline fleet if the longline bigeye tuna and yellowfin tuna catch limits are reached in any calendar year under the action alternatives would not be expected to lead to substantial direct or indirect effects on swordfish (the U.S. WPCO purse seine fleet does not generally catch swordfish). If both the shallow-set and deep-set longline fisheries are closed

when a catch limit is reached in a calendar year, then similar to the effects on bigeye, yellowfin, and skipjack tuna, there could be a potential for direct and indirect beneficial impacts to swordfish, since there would be reduced fishing pressure on the stock, which is targeted in the Hawaii-based shallow-set fishery. If only the deep-set fishery if closed or if there is a prohibition on retention, transshipment and landing of bigeye and yellowfin tuna, then there could be some increased fishing pressure on swordfish with resulting adverse direct and indirect effects over the No-Action Alternative, if vessels switch to shallow-setting. However, as vessels tend to retain swordfish earlier in the year (see Figure 11), and it is likely that the bigeye and yellowfin catch limits would be reached later in the year, any increased fishing pressure on swordfish from implementation of the action alternatives is not expected to be substantial.

Because the longline bigeye tuna and yellowfin tuna catch limits would be more restrictive under Alternatives C, D, and H, these alternatives would be expected to have an increased potential for effects to albacore and swordfish over the other action alternatives.

4.7 *Non-Target Fish Species*

This section presents the analysis of the potential impacts that could be caused by the No-Action Alternative and each of the action alternatives analyzed in depth in this PEA to other non-target fish species by U.S. purse seine or longline fleets fishing in the Convention Area.

4.7.1 **Alternative A, No-Action Alternative**

Under Alternative A, the No-Action Alternative, the management measures in the action alternatives for the U.S. purse seine and longline fisheries in the Convention Area would not be implemented. Thus, there would be no direct changes to the fishing patterns of the fleet and no resulting direct effects to non-target fish species. As discussed above in Section 4.5.1, it is conceivable that the indirect, or long-term, effects of the No-Action Alternative on bigeye tuna, skipjack tuna, and yellowfin tuna would be negative, should this alternative lead to increased fishing pressure on the stocks, relative to the action alternatives. Any such increased fishing pressure could also lead to long-term negative effects on non-target fish species that are caught by the U.S. WCPO purse seine fleet or in the Hawaii-based longline fisheries. However, as shown in Table 12, Table 13, and Table 14 in Chapter 3, the U.S. WCPO purse seine fleet and the Hawaii-based longline fleet does not generally catch a substantial amount of other fish species. Also, given that many other factors influence the status of non-target fish species (e.g., fisheries that target those species, oceanic conditions), it is unlikely that there would be any indirect effects to non-target species under the No-Action Alternative, stemming from lack of implementation of any of the action alternatives.

4.7.2 **Action Alternatives**

Under Alternatives B, C, D, E, F, G, H, I, J, and K, there could be some change in the amount and type of non-target fish species caught by the U.S. WCPO purse seine fleet and the Hawaii-based longline fleet. Direct impacts to non-target fish species would include a potential increase in the catch of some species and a decrease in the catch of other species, due to the changes in

fishing patterns and practices of the fleets and the potential for an overall decrease in fishing effort due to implementation of the fishery closures for the U.S. WCPO purse seine fleet under some of the alternatives, the fishing catch and effort limits and any associated fishery closures, and the shift in fishing to unassociated sets during the implementation of any purse seine FAD setting restrictions as well as shifts of fishing effort to the EPO or to the EEZs of PIC. Indirect or long-term effects would include the greater potential for adverse effects to the stocks of non-target fish species that experience increased fishing mortality and reduced potential for adverse effects to the stocks of non-target fish species that experience decreased fishing mortality. Because the U.S. WCPO purse seine fleet and the Hawaii-based longline fleet do not generally catch large amounts of other non-target fish species (see Table 12, Table 13, and Table 14 in Chapter 3), the overall direct and indirect effect on non-target fish species under any of the action alternatives would be expected to be minor or negligible. The action alternatives with a greater potential for beneficial effects to the stocks of bigeye, yellowfin, and skipjack tuna would likewise have a greater potential for effects to non-target fish species. Such effects on non-target fish species would either be beneficial or adverse, depending on whether the non-target fish species experiences increased or decreased fishing mortality.

4.8 *Protected Resources*

This section presents the analysis of the potential impacts that could be caused by the No-Action Alternative and each of the action alternatives analyzed in depth in this PEA to protected resources in the Convention Area.

4.8.1 **Alternative A, No-Action Alternative**

Under Alternative a, the No-Action Alternative, the management measures in the action alternatives for the U.S. purse seine and longline fisheries in the Convention Area would not be implemented. Thus, there would be no direct changes to the fishing patterns of the fleet and no resulting direct effects to protected resources. As discussed above, in Section 4.5.1, it is conceivable that the indirect, or long-term, effects of the No-Action Alternative on bigeye tuna, skipjack tuna, and yellowfin tuna would be negative, should this alternative lead to increased fishing pressure on the stocks, relative to the action alternatives. Any such increased fishing pressure could also lead to long-term negative effects on protected resources with which the U.S. WCPO purse seine fleet and the Hawaii-based longline fleet interacts. However, given that many other factors influence the status of those species (e.g., other fisheries, oceanic conditions), it is unlikely that there would be any substantive indirect effects to protected resources stemming from lack of implementation of the action alternatives under the No-Action Alternative.

4.8.2 **Action Alternatives, the U.S. WCPO Purse Seine Fishery**

Based on incomplete and unverified observer data from FFA, the U.S. purse seine fishery has had limited interactions with marine mammals in recent years. The number of these interactions and whether the marine mammals were ESA-listed species is unknown at this time. NMFS is continuing to collect and analyze data. Data also indicates that the U.S. purse seine fleet has had

some interaction with sea turtles in the WCPO, but the U.S. WCPO purse seine fleet has not been known to interact with seabirds. The Final Biological Opinion and Incidental Take Statement for the U.S. purse seine fishery for effects to ESA-listed turtles and marine mammals was issued on November 1, 2006, concluding that continued operation of the fishery is not likely to jeopardize the continued existence of the listed turtles and marine mammals. As stated in Chapter 3, in a memorandum dated October 21, 2014, NMFS analyzed the effects of the U.S. purse seine fishery on the Indo-West Pacific DPS of the scalloped hammerhead shark pending completion of formal ESA Section 7 consultation during the 2015 calendar year. Based on the best available information, NMFS determined that risk of the continued operation of the U.S. WCPO purse seine fishery on the Indo-West Pacific DPS of the scalloped hammerhead shark during calendar year 2015 is negligible and not likely to jeopardize the continued existence of the DPS.

Overall, the direct and indirect effects to protected species from the implementation of the action alternatives would likely be negligible, although it is possible there would be a reduction in interactions with protected species from a reduction in fishing effort under the alternatives. To the extent that there is a shift in fishing patterns and practices, from FAD sets to unassociated sets or to fishing in the EPO or the EEZs of PIC, any effects in terms of interactions with protected resources would be expected to be small compared to typical year-to-year variations in interactions with species driven by changing oceanic and economic conditions. Action Alternatives C, D, G, and H would be expected to have more potential for reduction in interactions with listed species over the No-Action Alternative, since there is more potential for reduced fishing effort under these alternatives. However, should implementation of any of these alternatives cause vessels be reflagged to other fleets operating in the WCPO that have less stringent measures for protected species, such reductions in interactions from reduced fishing effort could be counteracted (see Rausser, Hamilton, Kovach et al. 2009 for discussion of transfer effects in fisheries).

The action alternatives would not cause any effects to ESA-listed species that have not been addressed in prior or ongoing consultations and would not cause additional impacts to marine mammals protected under the MMPA.

The changes in fishing patterns and practices of the fleet would not affect the following areas designated as EFH or HAPC: ocean or coastal habitats; historic properties listed in or eligible for listing in the National Register of Historic Places; or NWRs or National Monuments. Such resources would not be affected because the potential changes in fishing patterns and practices of the fleet would take place in areas of the ocean far from shorelines and would not affect the seafloor or benthic habitats since purse seine fishing does not involve contact with the seafloor (see Section 3.2 of this PEA for a description of purse seine fishing). Also, because any effects to fish stocks would be minor or negligible, as discussed above, any pelagic fish habitat designated as EFH, including the water column, or HAPC, would not be expected to experience any substantial effects – either beneficial or adverse – from implementation of any of the action alternatives, as the small effects on the stocks would be unlikely to lead to any indirect effects to fish habitat (e.g., an increase in predator or prey leading to trophic interactive effects leading to effects on habitat). In addition, as discussed in Section 3.8 of this PEA, commercial fishing is

already prohibited in the Monuments. Shipwrecks would be the only known cultural objects potentially within the affected environment. However, as stated above, purse seine fishing operations do not come into contact with the seafloor, so the operations of the U.S. WCPO purse seine fleet would not be expected to affect any material from shipwrecks, which typically rests on ocean bottoms.

4.8.3 **Action Alternatives, the Hawaii-Based Longline Fisheries**

As stated in Section 3.8, several biological opinions for the Hawaii-based longline fisheries have been recently completed for ESA-listed species under the jurisdiction of NMFS and USFWS. ESA-listed species not included in these biological opinions that could be affected by the longline fisheries were subject to separate informal consultations under Section 7 of the ESA.

Overall, the direct and indirect effects to protected species from the implementation of the action alternatives would likely be negligible, although it is possible there would be reduction in interactions with protected species from a reduction in fishing effort under the alternatives. However, should implementation of the action alternatives cause an increase in fishing effort in foreign fisheries that have less stringent measures for protected species, in order to meet market demands for bigeye tuna, such reductions in interactions from reduced fishing effort could be counteracted (see Rausser, Hamilton, Kovach et al. 2009 for discussion of transfer effects in fisheries). To the extent that there is a shift in fishing patterns and practices during any fishery closure, to the EPO or to shallow-set fishing, any effects in terms of interactions with protected resources would be expected to be small compared to typical year-to-year variations in interactions with species driven by changing oceanic and economic conditions. Action Alternatives C, D, G, and H would be expected to have more potential for reduction in interactions with listed species over the No-Action Alternative, since there is more potential for reduced fishing effort under these alternatives.

Overall, the action alternatives would not cause any effects to ESA-listed species that have not been addressed in prior or ongoing consultations and would not cause additional impacts to marine mammals protected under the MMPA.

The changes in fishing patterns and practices of the fleet would not affect the following areas designated as EFH or HAPC: ocean or coastal habitats; historic properties listed in or eligible for listing in the National Register of Historic Places; or NWRs or National Monuments. Such resources would not be affected because the potential changes in fishing patterns and practices of the fleet would take place in areas of the ocean far from shorelines and would not affect the seafloor or benthic habitats since longline fishing does not involve contact with the seafloor (see Section 3.3 of this PEA for a description of longline fishing). Also, because any effects to fish stocks would be minor or negligible, as discussed above, any pelagic fish habitat designated as EFH, including the water column, or HAPC, would not be expected to experience any substantial effects – either beneficial or adverse – from implementation of any of the action alternatives, as the small effects on the stocks would be unlikely to lead to any indirect effects to fish habitat (e.g., an increase in predator or prey leading to trophic interactive effects leading to effects on habitat). In addition, as discussed in Section 3.8 of this PEA, commercial fishing is already prohibited in the Monuments. Shipwrecks would be the only known cultural objects potentially

within the affected environment. However, as stated above, longline fishing operations do not come into contact with the seafloor, so the operations of the Hawaii-based longline fleet would not be expected to affect any material from shipwrecks, which typically rests on ocean bottoms.

4.9 *Environmental Justice*

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," states that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." As discussed throughout this chapter, the overall environmental effects from any of the action alternatives would not be expected to be substantial and generally would be distributed evenly among the affected vessels in the fleets. Implementation of any of the action alternatives would not be expected to result in disproportionately high and adverse human health or environmental effects on vessel owners or operators in the affected fleets. Thus, none of the alternatives considered would result in significant and adverse environmental effects on minority or low-income populations.

4.10 *Comparison of Alternatives*

Table 19 below summarizes and compares the impacts of the No-Action Alternatives and the 11 action alternatives. analyzed in depth in this PEA.

Table 19: Comparison of Alternatives

Alternative	Effects on Fleets	Effects on Bigeye, Yellowfin, Skipjack	Effects on Albacore and Swordfish	Effects on other non-target fish species	Effects on Protected Resources	Effects on Environ-mental Justice
Alternative A, No Action	None	No direct effects; potential minor and negative indirect effects	None	None	None	None
Alternative B, Least Restrictive	Possible reduction in purse seine fishing effort, small shift to unassociated purse seine sets; possible closure of Hawaii-based longline	Small and beneficial potential direct and indirect effects	Likely none on albacore; minor effects on swordfish	Minor or negligible	Small or negligible	None

	fisheries					
Alternative C, Most Restrictive	Largest reduction in purse seine fishing effort, small shift to unassociated purse seine sets; possible closure of Hawaii-based longline fisheries – longer than Alternative B	Small and beneficial potential direct and indirect effects; More than Alternative B, but not substantial	Likely none on albacore; minor effects on swordfish; More than Alernative B	Minor or neglible	Small or negligible	None
Alternative D, Most Restrictive FAD setting prohibition Variation	Larger potential shift to unassociated purse seine sets than other alternatives, possible closure of Hawaii-based longline fisheries – longer than Alternative B	Small and beneficial potential direct and indirect effects; Likely more than Alternative C, but not substantial	Same as Alternative C	Minor or neglible	Small or negligible	None
Alternative E, Additional FAD setting prohibition Period	Same as Alternative B, except slightly larger shift to unassociated purse seine sets, possible closure of Hawaii-based longline fisheries – same Alternative B	Small and beneficial potential direct and indirect effects, More than Alternative B	Same as Alternative B	Minor or neglible	Small or negligible	None
Alternative F, FAD Set Limit Variation	Same as Alternative B, except slightly larger shift to unassociated purse seine sets, possible closure of Hawaii-based longline fisheries – same Alternative B	Small and beneficial potential direct and indirect effects, More than Alternative B	Same as Alternative B	Minor or neglible	Small or negligible	None
Alternative G, Total Purse Seine Closure Variation	Definite reduction in purse seine fishing effort, small potential shift to unassociated purse seine sets, possible closure of Hawaii-based longline fisheries – same	Small and beneficial potential direct and indirect effects, More than Alternative B	Same as Alternative B	Minor or neglible	Small or negligible	None

	Alternative B					
Alternative H, Most Restrictive Without High Seas FAD Closure	Same as Alternative C for purse seine fleet but no transfer to unassociated purse seine sets, possible closure of Hawaii-based longline fisheries – same Alternative C	Small and beneficial potential direct and indirect effects, Slightly less than Alternative C	Same as Alternative C	Minor or neglible	Small or negligible	None
Alternative I, Variation on Purse Seine Fishing Effort Limits	Same as Alternative B, but more potential for reduction in purse seine fishing effort, possible closure of Hawaii-based longline fisheries – same Alternative B	Small and beneficial potential direct and indirect effects, More than Alternative B	Same as Alternative B	Minor or neglible	Small or negligible	None
Alternative J, Variation on Purse Seine Fishing Effort Limits, Separate Areas	Same as Alternative I, but more potential for reduction in purse seine fishing effort, possible closure of Hawaii-based longline fisheries – same Alternative B	Small and beneficial potential direct and indirect effects, More than Alternative B and I	Same as Alternative B	Minor or neglible	Small or negligible	None
Alternative K, Multiyear Limits	Less restrictive than Alternative B	Small and beneficial potential direct and indirect effects; Least of all the action alternatives	Same as Alternative B	Minor or neglible	Small or negligible	None

Chapter 5 Cumulative Impacts

This chapter presents the cumulative impacts analysis for the PEA.

A cumulative impact is defined by the CEQ's regulations at 40 CFR § 1508.7 as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." And further: "cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." The cumulative impacts analysis examines whether the direct and indirect effects of the proposed action and alternatives on a given resource interact with the direct and indirect effects of other actions on that same resource to determine the overall, or cumulative effects, on that resource.

Before beginning a cumulative impacts analysis, the geographic area of the analysis and the time frame for the analysis must be identified to determine the appropriate scope for the analysis (CEQ 1997). The geographic area of the analysis here is the Pacific Ocean area as described in Chapter 3. The time frame for this analysis is from 2009 – when the United States first implemented a WCPFC decision for the management of tropical tunas through rulemakings with effects on the environment similar to the effects that would be caused by implementation of any of the action alternatives – to 2020, the end date for the scope of this PEA.

Section 5.1 provides some additional information on the affected environment, Section 5.2 describes the identified past, present, and reasonably foreseeable future actions during the 2009-2020 time period, and Section 5.3 presents the cumulative effects analysis.

5.1 Affected Environment

Chapter 3 describes the affected environment that could be affected by the proposed action under any of the alternatives studied in depth. Chapter 3 sets forth the baseline for assessing the direct and indirect impacts of the proposed action, as presented in Chapter 4.

5.2 Past, Present, and Reasonably Foreseeable Future Actions

This section describes the other actions in the period 2009-2020 affect the same resources in the affected environment as would be affected by implementation of any of the action alternatives analyzed in depth in this PEA. The analysis of cumulative impacts is presented in the following section.

5.2.1 Past Actions

Past actions include:

- NMFS' implementation of the purse seine provisions of CMM 2008-01, 2011-01, 2012-01, and 2013-01 through the 2009 Rule, the 2011 Rule, the 2013 Rule, and the 2014 Rule, as discussed in Chapter 1 of this EA and final rule to implement restrictions on the use of FADs for 2015 (see final rule published December 29, 2014, at 79 FR 77942).
- NMFS implementation of the ELAPS limit for 2015 (see interim rule published May 21, 2015, at 80 FR 29220).
- NMFS' implementation of the longline provision of CMM 2008-01, CMM 2011-01, and CMM 2012-01, which was essentially implementation of a 3,763 catch limit for bigeye tuna for the U.S. longline fleets operating in the Convention Area for the years 2009-2014 (see final rule published December 7, 2009, at 74 FR 63999; final rule published August 27, 2012 at 77 FR 51709; and final rule published September 23, 2013, at 78 FR 58240).
- U.S implementation of the IATTC decisions for tropical tunas in the EPO in 2009, 2011, and 2013, which include bigeye tuna catch limits for longline fisheries and closed areas and periods for purse seine fishing for the years 2009 through 2016 (see final rule published November 23, 2009, at 74 FR 61046; final rule published November 4, 2011, at 76 FR 68332; and final rule published April 9, 2014, at 79 FR 19487).
- NMFS issued a final rule that prohibits commercial fishing in the Pacific Remote Islands and Rose Atoll Monuments, and in the Islands Units of the Marianas Trench Monument; establishes management measure for non-commercial and recreational charter fishing in the Monuments; and prohibits the conduct of commercial fishing outside the Monuments and non-commercial fishing inside the Monuments during the same trip (78 FR 32996; June 3, 2013).
- NMFS issued a final rule to implement provisions of several WCPFC CMMs on December 3, 2012 (77 FR 71501). The final rule, effective January 2, 2013, establishes notice, reporting, and observer coverage requirements for transshipments, requirements regarding notification of entry into or exit from a particular area of the high seas, and requirements regarding discards from purse seine vessels.
- Based on a WPRFMC recommendation, NMFS issued a final rule on June 11, 2012 (77 FR 34260), that modifies the boundaries of the American Samoa large vessel prohibited area to align with the boundaries of the Rose Atoll Marine National Monument, effective July 11, 2012.
- NMFS issued a final rule to implement for U.S. fishing vessels IATTC Resolution C-11-10, "Resolution on the Conservation of Oceanic Whitetip Sharks Caught in Association with Fisheries in the Antigua Convention Area" (76 FR 68332; November 4, 2011). Under this rule, oceanic whitetip shark may not be retained by U.S. HMS fishing vessels in the EPO.
- NMFS issued a final rule to implement for U.S. fishing vessels IATTC Resolution C-11-03, "Resolution Prohibiting Fishing on Data Buoys" (76 FR 68332; November 4, 2011).
- NMFS issued a final rule to implement WCPFC decisions on the oceanic whitetip shark, the whale shark, and the silky shark (80 FR 8807; February 19, 2015).

- NMFS issued a final rule to prohibit commercial fishing, while allowing for managed non-commercial fishing, in the expanded areas of the Pacific Remote Islands Marine National Monument, which includes the waters of the U.S. EEZ around Jarvis and Wake Islands and Johnston Atoll, consistent with Presidential Proclamation 9173, issued in September 2014 (80 FR 15693; March 25, 2015).
- NMFS issued a final rule to implement WPRFMC recommendations for an amendment to the Pelagics FEP that would set up a system for the assignment of WCPFC-imposed HMS catch limits among the United States and American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands, and a catch limit of 2,000 mt of longline-caught bigeye tuna for each territory for 2014, 1,000 mt of which could be allocated to eligible U.S. longline fishing vessels (79 FR 64097; October 28, 2014).
- The parties to the SPTT agreed on an interim arrangement for 2015 that provides for access by U.S. purse seine vessels to the waters of the Pacific Island parties to the SPTT; although the total number of fishing days under the arrangement is similar to previous agreements, the number of fishing days allowed in the Kiribati EEZ is only 300.
- In 2006 Kiribati formed the PIPA in its EEZ, which is about 140,000 square miles in size. On January 1, 2015, Kiribati banned all commercial fishing within a significant portion of the PIPA. This prohibition applies to the U.S. purse seine fleet.

5.2.2 Other Present Actions

Present actions include:

- Actions by other nations to implement CMM 2014-01, details of which are unknown at this time.

5.2.3 Reasonably Foreseeable Future Actions

Reasonably foreseeable future actions include:

- Actions by the United States and other nations to implement any additional management measures adopted by the WCPFC for resources in the affected environment, details of which are unknown at this time;
- Actions by the United States and other nations to implement a new multi-year IATTC management measure for tropical tunas for 2017 and beyond, details of which are unknown at this time; and
- Actions by the United States to implement a renegotiated SPTT, the specific details of which are unknown at this time.

5.3 Discussion of Cumulative Impacts

This section discusses cumulative impacts to the resources in the affected environment analyzed in Chapter 4 of this EA.

5.3.1 *Cumulative Impacts to Physical Resources and Climate Change*

As discussed in Chapter 4, implementation of any of the action alternatives or the No-Action Alternative would not be expected to have substantial impacts on physical resources in the WCPO or contribute to climate change. The other past, present, and reasonably foreseeable future actions identified in this chapter would similarly not be expected to substantially impact physical resources in the WCPO, since they are fishery management actions that would not be expected to impact physical resources. Based on all information to date, the other actions are also not expected to lead to a large increase in greenhouse gas emissions that would affect climate change. Thus, the cumulative impacts to physical resources and climate change from implementation of the action alternatives or the No-Action Alternative would not be expected to be substantial.

5.3.2 **Cumulative Impacts to Bigeye, Skipjack, and Yellowfin Tuna in the WCPO**

As discussed in Chapter 4, the direct and indirect effects from any of the action alternatives to bigeye, skipjack, and yellowfin tuna stocks in the WCPO could perhaps be somewhat beneficial when compared to the No-Action Alternative, but would not be expected to be substantial. Please see Table 19 in Chapter 4 for a summary of potential impacts from each of the action alternatives.

Past management actions identified above, which were intended to help to conserve the stocks, have also likely had, at the most, minor biological effects, since using the NMFS stock status determination criteria, the status of the stocks has not changed since 2009. The other identified present actions would also be expected to have minor effects on these stocks. The other present actions would implement the CMM 2014-01. CMM 2014-01 includes specific objectives for each of the three stocks: for each, the fishing mortality rate is to be reduced to or maintained at levels no greater than the fishing mortality rate associated with maximum sustainable yield. Based on the NMFS status determination criteria, as shown in Table 11, it is possible that full implementation of CMM 2014-01 by the United States and other WCPFC members could result in maintaining the stock status of skipjack tuna and yellowfin tuna as neither overfishing nor overfished, and change the stock status of bigeye tuna so it is also neither overfishing nor overfished. However, it is difficult to predict the results of full implementation of CMM 2014-01 at this time.

The details of the reasonably foreseeable future actions are unknown, and thus, specific assessment of each of their potential contributions to cumulative impacts on the stocks of bigeye tuna, skipjack tuna, and yellowfin tuna is not possible at this time. However, given the Commission's articulated objectives in CMM 2014-01 and the current status of the stocks, it is likely that the reasonably foreseeable future actions will be consistent with the objectives of CMM 2014-01.

Thus, the cumulative impacts from the identified past, present, and reasonably foreseeable future actions on the stocks of bigeye tuna, yellowfin tuna, and skipjack tuna in the WCPO would likely be beneficial in comparison to operation of the fishery absent the management measures that are being or would be implemented under the identified actions. However, it is unknown whether the

current status of the stocks will change as a collective result of all of these actions – though this is difficult to predict without knowing the details of the reasonably foreseeable future actions or the results of the implementation of the present actions. Based on all information to date, the cumulative impacts from implementation of any of the action alternatives or lack of implementation under the No-Action Alternative would not be expected to lead to substantial cumulative impacts on the status of the stocks of bigeye tuna, skipjack tuna, and yellowfin tuna in the WCPO.

5.3.3 **Cumulative Impacts to Other Target or Non-target Fish Species in the WCPO**

As stated in Chapter 4, the action alternative or the No-Action Alternative would not be expected to have substantial effects on other target or non-target fish species. Given that the other past, present and reasonably foreseeable future actions are fishery management actions, they similarly had or would similarly be expected to have minor effects on other target or non-target species if focused on management of the fisheries that target the same stocks, or effects that would decrease fishing pressure on the other non-target fish species if focused on management of those species, and thus, the cumulative effects on other target or non-target fish species would not be expected to be adverse or substantial.

5.3.4 **Cumulative Impacts to Protected Resources in the WCPO**

As discussed in Chapter 4, the action alternatives or No-Action Alternative would not be expected to increase or decrease interactions with protected resources, although it is possible there would be slight reduction in interactions with protected species under the action alternatives due the potential reduction in overall fishing effort compared to the No-Action Alternative. Based on all information to date, the other identified past, present, and reasonably foreseeable future action are not expected to have substantial effects on protected resources. Thus, the cumulative effects on protected resources would not be expected to be substantial.

5.3.5 **Cumulative Impacts to Environmental Justice**

As stated in Chapter 4, the action alternative or the No-Action Alternative would not substantially affect minority or low-income populations. Based on all information to date, the other past, present, and reasonably foreseeable future actions identified in this chapter are not expected to affect minority of low-income populations. Thus, the cumulative effects on minority or low-income populations would not be expected to be substantial.

Consultation

NAO 216-6 requires a listing of the agencies and persons who were consulted while preparing this EA. Table lists the agencies, NOAA units, and entities that were contacted for information.

Table 20: List of agencies and offices contacted

NMFS – Headquarters – Office of International Affairs
NMFS – Pacific Islands Regional Office – Observer Program
NMFS – Pacific Islands Regional Office – Sustainable Fisheries Division
NMFS – Pacific Islands Fisheries Science Center
NMFS – West Coast Regional Office – Sustainable Fisheries Division
NMFS – Southwest Science Center
NOAA Office of Law Enforcement
North Pacific Fishery Management Council
Pacific Fishery Management Council
Department of State – Office of Marine Conservation
U.S. Coast Guard – 14th Coast Guard District
Western Pacific Fishery Management Council

Literature Cited

Ainsworth, C. H., J.F. Samhouri, D.S. Busch, W.W.L. Cheung, J. Dunne, J. and T.A. Okey. 2011. Potential impacts of climate change on Northeast Pacific marine foodwebs and fisheries. *Ices Journal of Marine Science* 68(6): 1217-1229.

Allain, V. 2010. Trophic structure of the pelagic ecosystems of the western and central Pacific Ocean. WCPFC Report SC6-2010/EB- IP10. Nukualofa, Tonga, Western and Central Pacific Fisheries Commission.

Alverson, F.G. and C.L. Peterson. 1963. Synopsis of the biological data on bigeye tuna *Parathunnus sibi* (Temminck and Schlegel) 1844. FAO Fisheries Report 6(2):482-514. Rome, Food and Agriculture Organization for the United Nations.

Appleyard, S., P. Grewe, B. Innes, and R. Ward. 2001. Population structure of yellowfin tuna (*Thunnus albacares*) in the western Pacific Ocean, inferred from microsatellite loci. *Marine Biology* 139(2):383-393.

Baker, J.D., C.L. Littnan, and D.W. Johnston. 2006. Potential effects of sea level rise on the terrestrial habitats of endangered and endemic megafauna in the Northwestern Hawaiian Islands. *Endangered Species Research* 2: 21-30.

Bakun, A.1996. *Patterns in the ocean: Ocean processes and marine population dynamics*. La Jolla, California: California Sea Grant College System.

Bala, G., K. Caldeira, and R. Nemani. 2010. Fast versus slow response in climate change: implications for the global hydrological cycle. *Climate Dynamics* 35: 423–434.

Begon, M., C.A. Townsend, and J.L. Harper. 2006. *Ecology: From Individuals to Ecosystems*. Hoboken, New Jersey: Wiley-Blackwell.

Blackburn, M. 1965. Oceanography and ecology of tunas. *Oceanography and Marine Biology: An Annual Review* 3:299-322.

Boggs, C.H. 1992. Depth, capture time, and hooked longevity of longline-caught pelagic fish: Timing bites of fish with chips. *Fishery Bulletin* 90(4):642-658.

Calkins, T.P. 1980. Synopsis of biological data on the bigeye tuna, *Thunnus obesus* (Lowe, 1839), in the Pacific Ocean. *In* Bayliff, W.H. (ed.) Synopses of Biological Data on Eight Species of Scombrids. IATTC Special Report 2. La Jolla, California, InterAmerican Tropical Tuna Commission.

Carpenter, K.E., M. Abrar, G. Aeby, R.B. Aronson, S. Banks, A. Bruckner, A. Chiriboga, J. Cortés, J.C. Delbeek, L. DeVantier, et al. 2008. One-Third of Reef-Building Corals Face Elevated Extinction Risk from Climate Change and Local Impacts. *Science* 321: 560-563.

Chavez, F.P., J. Ryan, S.E. Lluch-Cota, and C.M. Niquen. 2003. From anchovies to sardines and back: Multidecadal change in the Pacific Ocean. *Science* 299(5604):217-221.

Cole, J.S. 1980. Synopsis of biological data on the yellowfin tuna *(Thunnus albacares)* (Bonnaterre 1788) in the Pacific Ocean. IATTC Special Report 2:75-150. La Jolla, California, Inter-American Tropical Tuna Commission.

Collette, B.B. and C.E. Nauen. 1983. *Scombrids of the world: An annotated and illustrated catalogue of tunas, mackerels, bonitos, and related species known to date*. Rome: Food and Agriculture Organization for the United Nations.

Council on Environmental Quality. 1981. *Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations*. 46 FR 18026 (March 23, 1981).

Council on Environmental Quality. 1997. Considering cumulative effects under the National Environmental Policy Act. Washington, D.C., Executive Office of the President of the United States.

Coan, A.L., G.T. Sakagawa, G. Yamasaki. 2002. The 2001 U.S. purse seine fishery for tropical tunas in the central-western Pacific [FTWG-1]. Noumea, New Caledonia: SPC, Secretariat of the Pacific Community. Standing Committee on Tuna and Billfish, Honolulu, Hawaii, USA 22-27 July 2002, 15th. 10 p.

Cox, S.P., T.E. Essington, J.F. Kitchell, S.J.D. Martell, C.J. Walters, C. Boggs, and I. Kaplan. 2002. Reconstructing ecosystem dynamics in the central Pacific Ocean, 19521998. II. A preliminary assessment of the trophic impacts of fishing and effects on tuna dynamics. *Canadian Journal of Fisheries and Aquatic Sciences* 59:1736-1747.

Dagorn, L., K.N. Holland, J.P. Hallier, M. Taquet, G. Moreno, G. Sancho, D.G. Itano et al. 2006. Deep diving behavior observed in yellowfin tuna (*Thunnus albacares*). *Aquatic Living Resources* 19:85-88.

Dambacher, J.M., J.W. Young, R.J. Olson, V. Allain, F. Galván-Magaña, M. J. Lansdell, N. Bocanegra-Castillo, V. Alatorre-Ramírez, S. P. Cooper, and L.M. Duffy. 2010. Analyzing pelagic food webs leading to top predators in the Pacific Ocean: A graph-theoretic approach. *Progress in Oceanography* 86(1-2):152-165.

Dizon, A. E., W.H. Neill, and J.J. Magnuson. 1977. Rapid temperature compensation of volitional swimming speeds and lethal temperatures in tropical tunas (Scombridae). *Environmental Biology of Fishes* 2(1): 83-92.

Edwards, M., M. Heath, and A. McQuatters-Gollop. 2010. Plankton in MCCIP Annual Report Card 2010-11, MCCIP Science Review: 10.

Ehrhardt, N.M., R.J. Robbins, and F. Arocha. 1996. Age validation and growth of swordfish, *Xiphias gladius*, in the northwest Atlantic. *Collected Volume of Scientific Papers* 45(2):358-367.

Ely, B., J. Vinas, J.R. Alvarado Bremer, D. Black, L. Lucas, K. Covello, A.V. Labrie et al. 2005. Consequences of the historical demography on the global population structure of two highly migratory cosmopolitan marine fishes: The yellowfin tuna (*Thunnus albacares*) and the skipjack tuna (*Katsuwonus pelamis*). *Biomed Central Evolutionary Biology* 2005(5):19.

Farby, V.J., B.A. Seibel, R.A. Feely, and J.C. Orr. 2008. Impacts of ocean acidification on marine fauna and ecosystem processes. *ICES Journal of Marine Science* 65: 414–432.

Fonteneau, A. 1991. Sea mounts and tuna in the tropical eastern Atlantic. *Aquatic Living Resources* 4(1):13-25.

Foreman, T.J. 1980. Synopsis of biological data on the albacore, *Thunnus alalunga* (Bonnaterre, 1788), in the Pacific Ocean. *In* W.H. Bayliff (ed.) Synopses of Biological Data on Eight Species of Scombrids. IATTC Special Report No. 2, 17-70. La Jolla, California, Inter-American Tropical Tuna Commission.

Galbraith, H., R. Jones, R. Park, J. Clough, S. Herrod-Julius, B. Harrington and G. Page. 2002. Global Climate Change and Sea Level Rise: Potential Losses of Intertidal Habitat for Shorebirds. *The International Journal of Waterbird Biology* 25(2):173-183.

Gillet, R. and A. Langley. 2007. Tuna for tomorrow? Some of the science behind an important fishery in the Pacific Islands. Noumea, New Caledonia, Asian Development Bank and Secretariat of the Pacific Community.

Gillett, R.D., M.A. McCoy, and D.G. Itano. 2002. *Status of the United States Western Pacific tuna purse seine fleet and factors affecting its future*. University of Hawaii-NOAA, Joint Institute for Marine and Atmospheric Research.

Graham, B.S., D. Grubbs, K. Holland, and B.N. Popp. 2007. A rapid ontogenetic shift in the diet of juvenile yellowfin tuna from Hawaii. *Marine Biology* 150:647–658.

Grewe, P.M. and J. Hampton. 1998. An assessment of bigeye (*Thunnus obesus*) population structure in the Pacific Ocean based on mitochondrial DNA and DNA microsatellite analysis. Hobart, Australia, Australian Commonwealth Scientific and Research Organization.

Halpern, B.S., K. Cottenie, and B.R. Broitman. 2006. Strong Top-Down Control in Southern California Kelp Forest Ecosystems. *Science* 312(5777): 1230-1232.

Hampton, J. and K. Bailey. 1993. Fishing for tunas associated with floating objects: A review of the western Pacific fishery. SPC Report 31. Noumea, New Caledonia, South Pacific Commission, Tuna and Billfish Assessment Programme, South Pacific Commission.

Hampton, J., K. Bigelow, and M. Labelle. 1998. A summary of current information on the biology, fisheries, and stock assessment of bigeye tuna (*Thunnus obesus*) in the Pacific Ocean, with recommendations for data requirements and future research. SPC Report 36. Noumea, New Caledonia, Oceanic Fisheries Programme, Secretariat of the Pacific Community.

Hampton, J., P. Kleiber, and A. Langley. 2006. Stock assessment of bigeye tuna in the western and central Pacific Ocean, including an analysis of management options. WCPFC Report SC2 SA WP-2. Pohnpei, Federated States of Micronesia, Western and Central Pacific Fisheries Commission.

Hampton, J., and G. Pilling. 2014. Relative impacts of FAD and free-school purse seine fishing on yellowfin tuna stock status. WCPFC-SC10-2014/MI-WP-05. Majuro, Republic of the Marshall Islands, Western and Central Pacific Fisheries Commission.

Hanamoto, E. 1987. Effect of oceanographic environment on bigeye tuna distribution. *Bulletin of the Japanese Society of Fisheries Oceanography* 51:203-216.

Harley, S. J., A.M. Berger, G.M. Pilling, N. Davies, and J. Hampton. 2012. Evaluation of stock status of bigeye, skipjack, and yellowfin tunas and southwest Pacific striped marlin against potential limit reference points. WCPFC-SC8-2012/MI-WP-01. Busan, Republic of Korea, Western and Central Pacific Fisheries Commission.

Hays, G.C., A.J. Richardson, and C. Robinson. 2005. Climate change and marine plankton. *Trends in Ecology and Evolution* 20(6): 337-344.

Hinke, J.T., I.C. Kaplan, K. Aydin, G.M. Watters, R.J. Olson, and J.F. Kitchell. 2004. Visualizing the Food-Web Effects of Fishing for Tunas in the Pacific Ocean. Ecology and Society 9(1): 10.

Hoegh-Guldberg, O., and J. Bruno. 2010. The Impact of Climate Change on the World's Marine Ecosystems. *Science* 328: 1523-1528.

Hoegh-Guldberg, O., P. J. Mumby, A. J. Hooten, R. S. Steneck, P. Greenfield, E. Gomez, C. D. Harvell, et al. 2007. Coral reefs under rapid climate change and ocean acidification. *Science* 318(5857): 1737-1742.

Holland, K., P. Kleiber, and S. Kajiura. 1999. Different residence times of bigeye and yellowfin tuna occurring in mixed aggregations over a seamount. *Fisheries Bulletin* 97:392-395.

Hunter, J.R., B. J. Macewicz, and J.R. Sibert. 1986. The Spawning Frequency of Skipjack Tuna, *Katsuwonus Pelamis*, From the South Pacific. *Fishery Bulletin* 84(4): 895-903.

Intergovernmental Panel on Climate Change. 2007. Climate change 2007: Synthesis report. An assessment of the Intergovernmental Panel on Climate Change, IPCC Plenary Session XXVII, Valencia, Spain.

Itano, D.G. 2000. The reproductive biology of yellowfin tuna (*Thunnus Albacares*) in Hawaiian waters and the western tropical Pacific Ocean: Project summary. SOEST/Jimar Report SOEST contribution 00-01 JIMAR Contribution 00-328. Honolulu, Joint Institute for Marine and

Atmospheric Research and the School for Ocean and Earth Science and Technology, University of Hawaii.

Joseph, J. 2003. Managing fishing capacity of the world tuna fleet. FAO Fisheries Circular Number 982. Rome, Food and Agriculture Organization of the United Nations.

Kaeriyama, M., H. Seo, H. Kudo, and M. Nagata. 2012. Perspectives on wild and hatchery salmon interactions at sea, potential climate effects on Japanese chum salmon, and the need for sustainable salmon fishery management reform in Japan. *Environmental Biology of Fishes* 94(1): 165-177.

Kamikuri, S., I. Motoyama, H. Nishi, and M. Iwai. 2009. Evolution of Eastern Pacific Warm Pool and upwelling processes since the middle Miocene based on analysis of radiolarian assemblages: Response to Indonesian and Central American Seaways. *Palaeogeography, Palaeoclimatology, Palaeoecology* 280: 469-479.

Katz, S.L., R. Zabel, C. Harvey, T. Good, and P. Levin. 2003. Ecological sustainable yield. *American Scientist* 91:1-150.

Kitchell J.F., C.H. Boggs, X. He, and C. Walters. 1999. Keystone predators in the central Pacific. In: Ecosystem approaches for Fisheries Management. Alaska Sea Grant College Program: 665-683.

Kume, S. 1967. Distribution and migration of bigeye tuna in the Pacific Ocean. *Report of the Nankai Regional Fisheries Research Laboratory* 25:75-80.

Langley, A.D. 2006. The South Pacific albacore fishery: A summary of the status of the stock and fishery management issues of relevance to Pacific Island countries and territories. Noumea, New Caledonia, Oceanic Fisheries Programme, Secretariat of the Pacific Community.

Langley, A.D., W.J. Hampton, P.M. Kleiber, and S.D. Hoyle. 2008. Stock assessment of bigeye tuna in the western and central Pacific ocean, including an analysis of management options. WCPFC Report SC4-2008/SA-WP-1. Noumea, New Caledonia, Oceanic Fisheries Programme, Secretariat of the Pacific Community.

Langley, A., P. Williams, P. Lehodey, and J. Hampton. 2004. The western and central Pacific tuna fishery 2003: Overview and status of tuna stocks. Noumea, New Caledonia, Oceanic Fisheries Programme, Secretariat of the Pacific Community.

Laurs, R.M. and R.J. Lynn. North Pacific albacore ecology and oceanography. 1991. North Pacific Transition Zone Workshop, Honolulu, 9-11 May, 1988. NOAA Report TRNMFS-105. Honolulu, United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Lehodey, P., M. Bertignac, J. Hampton, A. Lewis, and J. Picaut. 1997. El Niño Southern Oscillation and tuna in the western Pacific. *Nature* 389(6652):715-718.

Link, J. 2002. Does food web theory work for marine ecosystems? *Marine Ecology Progress Series* 230:1-9.

Loukos, H., P. Monfray, L. Bopp, and P. Lehodey. 2003. Potential changes in skipjack tuna (*Katsuwonus pelamis*) habitat from a global warming scenario: modeling approach and preliminary results. *Fisheries Oceanography* 12(4-5):474-482.

Matsumoto, T., T. Kitagawa, and S. Kimura. 2013. Vertical behavior of bigeye tuna (*Thunnus obesus*) in the northwestern Pacific Ocean based on archival tag data. *Fisheries Oceanography* 23(3): 234-246.

Matsumoto, T., K. Satoha, and M. Toyonagaba. 2014. Behavior of skipjack tuna (*Katsuwonus pelamis*) associated with a drifting FAD monitored with ultrasonic transmitters in the equatorial central Pacific Ocean. *Fisheries Research* 157: 78-85.

Mayfield A.B., Chan P., H.M. Putnam, C. Chen, and T. Yung Fan. 2012. The effects of a variable temperature regime on the physiology of 10 the reef-building coral *Seriatopora hystrix*: results from a laboratory-based reciprocal transplant. *The Journal of experimental Biology* 215(23): 4183-4195.

McCoy, M. and R. Gillet. 1998. Foreign tuna purse seining in the Pacific Islands: The current situation and business opportunities. Honiara, Solomon Islands, Pacific Islands Forum Fisheries Agency.

Miyabe, N. 1994. A review of the biology and fisheries for bigeye tuna, *Thunnus obesus*, in the Pacific Ocean. FAO Fisheries Report T336 Volume 2. Rome, Food and Agriculture Organization for the United Nations.

Miyabe, N. and W.H. Bayliff. 1998. A review of information on the biology, fisheries, and stock assessment of bigeye tuna, *Thunnus obesus*, in the Pacific Ocean. In Deriso, R.B., W.H. Bayliff, and N.J. Webb (eds.) Proceedings of the First World Meeting on Bigeye Tuna, 129-170. La Jolla, California: Inter-American Tropical Tuna Commission.

MRAG Americas. 2002. Review of Ecosystem Bycatch Issues for the Western and Central Pacific Region. Prepared for the Preparatory Conference for the Western and Central Pacific Fisheries Commission (WCPFC) in Manila, Philippines.

Mugo, R., S. Saitoh, A. Nihira, and T. Kuroyama. 2010. Habitat characteristics of skipjack tuna (Katsuwonus pelamis) in the western North Pacific: a remote sensing perspective. Fisheries Oceanography 19(5): 382–396.

Munday, P.L., M.I. McCormick, and G.E. Nilsson. 2012. Impact of global warming and rising CO2 levels on coral reef fishes: what hope for the future? *Journal of Experimental Biology* 215(22): 3865-3873.

Nakamura, I. 1985. Billfishes of the world: An annotated and illustrated catalogue of marlins, sailfishes, spearfishes, and swordfishes known to date. *Fisheries Synopsis* 125(5):1-4.

National Marine Fisheries Service. 2004. Environmental assessment for the third extension of the South Pacific Tuna Treaty. Honolulu, United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Pacific Islands Regional Office.

National Marine Fisheries Service. 2005a. Final environmental impact statement on seabird interaction avoidance measures and pelagic squid fishery management. Honolulu, United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Pacific Islands Regional Office.

National Marine Fisheries Service, Southwest Fisheries Science Center. 2014. *Swordfish Research.* Retrieved from https://swfsc.noaa.gov/textblock.aspx?Division=FRD&ParentMenuId=141&id=1127 on April 3, 2015.

National Marine Fisheries Service. 2015a. Regulatory Impact Review for a Rule to Implement Decisions of the Western and Central Pacific Fisheries Commission for: Fishing Effort Limits in Purse Seine Fisheries for 2015. RIN 0648-BF03. Honolulu, United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Pacific Islands Regional Office.

National Marine Fisheries Service. 2015b. Regulatory Impact Review for a Rule to Implement Decisions of the Western and Central Pacific Fisheries Commission for: Fishing Effort and Catch Limits and Other Restrictions and Requirements. RIN 0648-BE84. Honolulu, United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Pacific Islands Regional Office.

National Weather Service. 2015. National Oceanic and Atmospheric Administration, National Weather Service, Climate Prediction Center. Web page accessed April 9, 2015: *www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/index.shtml*

Nikaido, H., N. Miyabe, and S. Ueyanagi. 1991. Spawning time frequency of bigeye tuna, *Thunnus obesus*. *Bulletin of Natural Resources: Institute of the Far Seas Fisheries* 28:47-73.

Niller, P.P. and R.W. Reynolds. 1984. The three-dimensional circulation near the eastern North Pacific subtropical front. *Journal of Physical Oceanography* 14(2): 217-230.

Nybakken, J.W. 1997. *Marine biology: An ecological approach*. New York: Addison-Wesley.

Olson, D.B., G.L. Hitchcock, A.J. Mariano, C.J. Ashjian, G. Peng, R.W. Nero, and G.P. Podesta. 1994. Life on the edge: Marine life and fronts. *Oceanography* 7(2): 52-60.

Paerl, H.W. 1997. Coastal Eutrophication and Harmful Algal Blooms: Importance of Atmospheric Deposition and Groundwater as "New" Nitrogen and Other Nutrient Sources. *Limnology and Oceanography*, 42(5, pt. 2): 1154-1165.

Palko, B.J., G.L. Beardsley, and W.J. Richards. 1981. Synopsis of the biology of the swordfish, *Xiphias gladius*. NOAA Report TR-NMFS-CIRC-441. Seattle, Washington, United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Perry, A.L., P.J. Low, J.R. Ellis, and J.D. Reynolds. 2005. Climate change and distribution shifts in marine fishes. *Science* 308(5730): 1912-1915.

Polovina, J.J. 1996. Decadal variation in the trans-Pacific migration of northern bluefin tuna (*Thunnus thynnus*) coherent with climate-induced change in prey abundance. *Fisheries Oceanography* 5(2):114-119.

Polovina, J.J., E. Howell, D.R. Kobayashi, and M.P. Seki. 2001. The transition zone chlorophyll front, a dynamic global feature defining migration and forage habitat for marine resources. Beyond El Niño conference: Climate variability and marine ecosystem impacts from the tropics to the Arctic, 49(1-4):469-483. La Jolla, California, United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center.

Polovina, J.J., D.R. Kobayashi, M.D. Parker, P.M. Seki, and H.G. Balazs. 2000. Turtles on the edge: Movement of loggerhead turtles (Caretta caretta) along oceanic fronts, spanning longline fishing grounds in the central North Pacific, 1997-1998. Fisheries Oceanography 9(1): 71-82.

Polovina, J.J., G.T. Mitchum, and G.T. Evans. 1995. Decadal and basin-scale variation in mixed layer depth and the impact on biological production in the central and North Pacific 1960-88. *Deep Sea Research* 142:1701-1716.

Rahmstorf, S. 2007. A Semi-Empirical Approach to Projecting Future Sea-Level Rise. *Science* 315: 368-370.

Rausser, G., Hamilton, S., Kovach, M., and Stifter, R. 2009. Unintended consequences: The spillover effects of common property regulations. *Marine Policy* 33:24-39.

Richardson, T.L., G.A. Jackson, H.W. Ducklow, and M.R. Roman. 2004. Planktonic food webs of the equatorial Pacific at 0°, 140° W: a synthesis of EqPac time-series carbon flux data. *Deep-Sea Research* I 51(9): 1245-1274.

Roden, G.I. 1980. On the subtropical frontal zone north of Hawaii during winter. *Journal of Physical Oceanography* 10(3): 342-362.

Roessig, J.M., C.M. Woodley, J.J. Cech, and L.J. Hansen. 2004. Effects of global climate change on marine and estuarine fishes and fisheries. *Reviews in Fish Biology and Fisheries* 14(2): 251-275.

Saito, S. 1973. Studies on fishing of albacore, *Thunnus alalunga* (Bonnaterre) by experimental deep-sea tuna long-line. *Memoirs of the Faculty of Fisheries* 21(2):107-184.

Schaefer, K. M., and D.W. Fuller. 2009. Horizontal movements of bigeye tuna (Thunnus obesus) in the eastern Pacific Ocean, as determined from conventional and archival tagging experiments initiated during 2000-2005. Inter-American Tuna Commision. Bulletin 24(2): 191-249.

Secretariat of the Pacific Community. 2001. A review of turtle by-catch in the western and central Pacific Ocean tuna fisheries. Noumea, New Caledonia, Oceanic Fisheries Programme, Secretariat of the Pacific Community

Secretariat of the Pacific Community. 2009. Preliminary review of the western and central Pacific Ocean purse seine fishery 2008. Oceanic Fisheries Programme, Secretariat of the Pacific Community.

Secretariat of the Pacific Community. 2012a. Status of the Purse Seine Fishery for 2011. A paper prepared for the Internal Meeting of the Pacific Island Parties for the U.S. Treaty Consultation 24th Annual Meeting February 25-27, 2012 Honolulu, Hawaii. Noumea, New Caledonia, Oceanic Fisheries Programme, Secretariat of the Pacific Community.

Secretariat of the Pacific Community. 2012b. Observer Scientific Data for 23rd LP (2010/2011). A paper prepared for the Internal Meeting of Pacific Island Parties to the U.S. Treaty Consultation 24th Annual Meeting March 25-27, 2012 Honolulu, Hawaii. Noumea, New Caledonia, Oceanic Fisheries Programme, Secretariat of the Pacific Community.

Secretariat of the Pacific Community. 2013a. Preliminary review of the western and Central Pacific Ocean purse seine fishery 2012. A paper prepared for the Internal Meeting of Pacific Island Parties to the South Pacific Regional US Multilateral Treaty May 3-7, 2013 Honiara, Solomon Islands. Noumea, New Caledonia, Oceanic Fisheries Programme, Secretariat of the Pacific Community.

Secretariat of the Pacific Community. 2013b. A Description of Observer Data Collected Under the US Multilateral Treaty and FSM Arrangement 2011-2012. A paper prepared for the Internal Meeting of Pacific Island Parties to the South Pacific Regional US Multilateral Treaty May 3-8, 2013 Honiara, Solomon Islands. Noumea, New Caledonia, Oceanic Fisheries Programme, Secretariat of the Pacific Community.

Secretariat of the Pacific Community Oceanic Fisheries Programme. 2013. Western and Central Pacific Fisheries Commission Tuna Fishery Yearbook 2012. Western and Central Pacific Fisheries Commission

Seki, M.P., R. Lumpkin, and P. Flament. 2002. Hawaii cyclonic eddies and blue marlin catches: The case study of the 1995 Hawaiian International Billfish Tournament. *Journal of Oceanography* 58(5): 739-745.

Sibert, J. and J. Hampton. 2003. Mobility of tropical tunas and the implications for fisheries management. Marine Policy 27(1):87-95.

Sibert, J., J. Hampton, P. Kleiber, and M. Maunder. 2006. Biomass, size, and trophic status of top predators in the Pacific Ocean. *Science* 314(5806):1773-1776.

Slomp, C.P. and P.V. Cappellen. 2004. Nutrient inputs to the coastal ocean through submarine groundwater discharge: controls and potential impact. *Journal of Hydrology* 295: 64–86.

Solomon, S., D. Quin, M. Manning, Z. Chen, M. Marquis, K.B. Avryt, M. Tignor et al. 2007. Summary for policy makers. In Climate Change 2007: The Physical Science Basis. WGI-IPCC Report 4. Cambridge and New York, Cambridge University Press.

Stewart. R.H. 2008. *Introduction to physical oceanography*. September 2008 Edition. College Station, Texas: Department of Oceanography, Texas A&M University.

Suzuki, Z. 1994. A review of the biology and fisheries for yellowfin tuna (*Thunnus albacares*) in the western and central Pacific Ocean. *In* Shomura, R. S., J. Majkowski, and S. Langi (eds.) Interactions of Pacific Tuna Fisheries. Volume 2: Papers on biology and fisheries, 108-137. Rome, Food and Agriculture Organization for the United Nations.

Suzuki, Z., P.K. Tomlinson, and M. Honma. 1978. Population structure of Pacific yellowfin tuna. *Inter-American Tropical Tuna Commission Bulletin* 17(5):227-446.

Suzuki, Z., Y. Warashina, and M. Kishida. 1977. The comparison of catches by regular and deep tuna longline gears in the western and central equatorial Pacific. *Bulletin of the Far Seas Fisheries Research Laboratory* 15:51-89.

Takahashi, M., H. Okamura, K. Yokawa, and M. Okazaki. 2003. Swimming behaviour and migration of a swordfish recorded by an archival tag. *Marine and Freshwater Research* 54(4):527-534.

Talley, L. D., G.L. Pickard, W.J. Emery, and J.H. Swift. 2011. *Descriptive physical oceanography: an introduction*. Burlington, Massachusetts: Academic press.

Tudela, S. 2004. Ecosystem effects of fishing in the Mediterranean: An analysis of the major threats of fishing gear and practices to biodiversity and marine habitats. Studies and reviews: General Fisheries Commission for the Mediterranean 74, 44. Rome: Food and Agriculture Organization for the United Nations.

Wang, X., C. Y. Chen, S. Truesdell, L. Xu, J. Cao, and W. Guan. 2014. The Large-Scale Deployment of Fish Aggregation Devices Alters Environmentally-Based Migratory Behavior of Skipjack Tuna in the Western Pacific Ocean. PLoS ONE 9(5): e98226.

Ward, P. and S. Elscot. 2000. Broadbill swordfish: Status of world fisheries. Report 3:208-213. Canberra, Australia, Bureau of Rural Sciences.

Ware, D.M., and R.E. Thomson. 2005. Bottom-up ecosystem trophic dynamics determine fish production in the northeast Pacific. *Science* 308:1280-1284.

Weng, J.S., M.K. Hung, C.C. Lai, L.J. Wul, M.A. Lee, and K.M. Liu. 2013. Fine-scale vertical and horizontal movements of juvenile yellowfin tuna (*Thunnus albacares*) associated with a subsurface fish aggregating device (FAD) off southwestern Taiwan. *Journal of Applied Ichthyology* 29: 990–1000.

Western Pacific Regional Fishery Management Council. 2009a. Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region. Honolulu, Western Pacific Fishery Management Council.

Western Pacific Regional Fishery Management Council. 2009b. Fishery Ecosystem Plan for the American Samoa Archipelago. Honolulu, Western Pacific Fishery Management Council.

Western Pacific Regional Fishery Management Council. 2013. Pelagic Fisheries of the Western Pacific Region: 2011 Annual Report. Honolulu, HI, WPFMC Report NA77FC0008. Honolulu, Western Pacific Fishery Management Council.

Western Pacific Regional Fishery Management Council. 2014. Pelagic Fisheries of the Western Pacific Region: 2012 Annual Report. Honolulu, HI.

Whitelaw, A.W. and V.K. Unithan. 1997.Synopsis on the distribution, biology, and fisheries of the bigeye tuna (*Thunnus obesus*) with a bibliography. Hobart, Australia, Australian Commonwealth Scientific and Research Organization.

Williams, P. 2003. Overview of the western and central Pacific Ocean tuna fisheries – 2002. Sixteenth Meeting of the Standing Committee on Tuna and Billfish 9–16 July. Working Paper GEN-1. Mooloolaba, Australia.

Williams, P. and P. Terawasi. 2014. Overview of the western and central Pacific Ocean tuna fisheries, including economic conditions – 2013. WCPFC-SC10-2014/GN WP-1. Majuro, Republic of the Marshall Islands, Western and Central Pacific Fisheries Commission.

Wilson, C. A. and J. M. Dean. 1983. The potential use of sagittae for estimating age of Atlantic swordfish, *Xiphias gladius*. Proceedings of the International Workshop on Age Determination of Oceanic Pelagic Fishes: Tunas, Billfishes and Sharks. NOAA Report TR-NMFS-8, 151-156. United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

van Woesik, R., P. Houk, A.L. Isechal, J.W. Idechong, S. Victor, and Y. Golbuu. 2012. Climate-change refugia in the sheltered bays of Palau: analogs of future reefs. *Ecology and Evolution* 2(10): 2474–2484.

The World Bank. 2000. *Cities, seas, and storms: managing change in Pacific Islands economies.* Volume IV: Adapting to climate change. Washington D.C.: The World Bank.

Appendix A

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
1845 Wasp Blvd., Bldg 176
Honolulu, Hawaii 96818
(808) 725-5000 • Fax (808) 725-5215

JUN 11 2015

MEMORANDUM FOR: The Record

FROM: Michael D. Tosatto
Regional Administrator

SUBJECT: Categorical Exclusion for the Establishment of a Framework Process to Implement Decisions of the Western and Central Pacific Fisheries Commission (RIN 0648-BE84)

NAO 216-6, Environmental Review Procedures, requires all proposed actions to be reviewed with respect to environmental consequences on the human environment. This memorandum summarizes the determination that the establishment of a framework process to implement decisions of the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (Commission) qualifies to be categorically excluded from further National Environmental Policy Act review.

Description of the Action

The National Marine Fisheries Service (NMFS) is undertaking notice and comment rulemaking under authority of the Western and Central Pacific Fisheries Convention Implementation Act (WCPFCIA) to establish a framework within which NMFS would specify fishing effort limits, catch limits, and other restrictions in U.S. fisheries for highly migratory species (HMS) in the area of application of the Convention (Convention Area) to implement particular decisions of the Commission.[1] The framework would not be used to implement all Commission decisions, but would be limited to those that are amenable to the framework process. For the purpose of the proposed framework, all such restrictions are called "limits."

The purpose of the framework is to make it possible to manage fisheries more responsively under conditions requiring "real time" management. Such conditions exist in the context of the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (Convention) because the Commission makes decisions that must be implemented by its members quickly – often within 60 days of the decision. The framework proposed here would allow NMFS to implement Commission decisions more rapidly than it otherwise would be able to accomplish. The proposed framework, in the form of

[1] The rule would also require that certain U.S. fishing vessels operating in the WCPO obtain "IMO numbers," the unique numbers issued under the ship identification number scheme of the International Maritime Organization (IMO) and includes other regulatory changes. Those elements of the rule are subject to a separate categorical exclusion document. NMFS has also prepared a Programmatic Environmental Assessment (PEA) to analyze implementation of specific management measures under the framework process. The PEA includes NEPA analysis for the components of the rule that would establish specific catch and effort limits for 2015-2017.

regulations to be codified at 50 CFR Part 300, Subpart O, contains the parameters within which NMFS could take specific actions, including the types of actions it could take, as well as the procedures for doing so. Specific actions taken by NMFS under the proposed framework, called "specifications," would be announced in the *Federal Register*. Except when warranted and allowed by law, specifications would be subject to public notice and comment. The limits specified under the framework would often, but not always, be time-limited.

The types of limits that would be specified under the framework include limits on the weight or number of fish that may be caught, retained, transshipped, landed, and/or sold; limits on the amount of fishing effort that may be expended, such as in terms of amounts of time vessels spend at sea or engaged in fishing or engaged in particular fishing activities or other measures of fishing effort, such as the number of gear sets or deployments of gear; and areas or periods in which particular fishing activities are restricted or prohibited.

For each limit included under the framework, NMFS would specify the area and period in which it applies, and as appropriate, the vessel types, gear types, species, fish sizes, and any other relevant attributes to which it applies. For spatial or temporal limits, NMFS would also specify the specific activities that would be restricted in the area or period, and for quantitative limits, NMFS would specify the restrictions that would go into effect after the limit is reached and the applicable dates of those restrictions. These restrictions could include a prohibition on the catch, retention, transshipment and/or landing of specific species or specific sizes of specific species, a prohibition on the use of specific fishing gears or methods, and restrictions on specific fishing activities.

In the decisions of the Commission, the three Participating Territories of the United States, American Samoa, the Commonwealth of the Northern Mariana Islands, and Guam, are often treated separately from the United States. For example, the fisheries of the territories are often subject to different controls and limits than are the fisheries of the United States. Therefore, to implement some Commission decisions, it is necessary to distinguish the fisheries from each other. This is not straightforward, since the fishing vessels participating in the different fisheries all share the same flag, that of the United States. The proposed regulatory framework would include criteria for distinguishing the fisheries from each other, such as for the purpose of attributing fishing effort and catch among the fisheries and for determining to which vessels a given restriction applies.

The proposed criteria follow those used in previous regulations issued under the WCPFC Implementation Act.[2]

---

[2] These regulations were subject to prior environmental analysis in the following documents: *Environmental Assessment for the Implementation of the Decisions of the Fifth Regular Annual Session of the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean: Fishing Restrictions and Observer Requirements in Purse Seine Fisheries for 2009-2011 and Turtle Mitigation Requirements in Purse Seine Fisheries and Bigeye Tuna Catch Limits in Longline Fisheries in 2009, 2010, and 2011; Supplemental Environmental Assessment for the Implementation of the Decisions of the Fifth Regular Annual Session of the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean: Specific Analysis on Bigeye Tuna Catch Limits in Longline Fisheries in 2009, 2010, and 2011; and Supplemental Environmental Assessment: Implementation of the Western and Central Pacific Fisheries Commission Bigeye Tuna Catch Limits for Longline Fisheries in 2012.*

Specifically, all fishing activities by U.S. fishing vessels would be considered to be part of a fishery of the United States except as follows:

(1) If catch is landed in American Samoa, Guam, or the Commonwealth of the Northern Mariana Islands, the catch and associated fishing effort is considered part of a fishery of the territory in which it is landed, provided that: (a) it was not caught using purse seine gear; (b) it was not caught in any portion of the EEZ other than the portion of the EEZ surrounding the territory in which it was landed; and (c) it was landed by a fishing vessel operated in compliance with a valid permit issued under §660.707 or §665.801 of this title.

(2) If catch is made by longline gear by a vessel registered for use under a valid American Samoa Longline Limited Access Permit issued under §665.801(c) of this title, the catch and associated fishing effort is considered part of a fishery of American Samoa, provided that: (a) it was not caught in any portion of the EEZ other than the portion of the EEZ surrounding American Samoa; and (b) it was landed by a fishing vessel operated in compliance with a valid permit issued under §660.707 or §665.801 of this title.

(3) If catch or fishing effort is made by a vessel that is included in a specified fishing agreement under §665.819(c) of this title, the catch and associated fishing effort is considered part of a fishery of American Samoa, Guam, or the Commonwealth of the Northern Mariana Islands, according to the terms of the agreement to the extent the agreement is consistent with §665.819(c) of this title and other applicable laws, provided that: (a) the start date specified in §665.819(c)(9)(i) of this title has occurred or passed; and (b) NMFS has not made a determination under §665.819(c)(9)(iii) of this title that the catch or fishing effort exceeds any limit allocated to the territory that is a party to the agreement.

The framework's procedures for specifying limits would be as follows: NMFS would publish in the *Federal Register* a notice of the proposed specification and a request for public comment on the proposed specification. The proposed specification would include all the relevant characteristics of the limit. After consideration of public comment received on the proposed specification, NMFS would publish in the *Federal Register* a notice of the final specification. For quantitative limits, NMFS would monitor catch or fishing effort with respect to the specified limit using data submitted in vessel logbooks and other available information. When NMFS estimates or projects that the specified limit has been or will be reached, NMFS would publish notification to that effect in the *Federal Register*. For quantitative limits, this *Federal Register* notice would include an advisement that specific activities will be restricted during a specific period. The notice would specify the restrictions and the specific activities to which they apply and the start and end dates and times of those restrictions. The start date of the restrictions would not be earlier than 7 days after the date of filing the closure notice for public inspection at the Office of the Federal Register.

Effects of the Action

The effects of the proposed action to establish a framework process would be purely administrative in nature. NMFS has implemented WCPFC decisions on HMS through specific regulations and may do so in the future. However, the establishment of the framework process through this proposed action would provide NMFS with the option of implementing certain WCPFC decisions through the framework process, generally more rapidly than otherwise. Due to its administrative nature, the proposed action would not contribute to any direct, indirect, or cumulative impacts on the human environment.

Categorical Exclusion

As defined in Sections 5.05 and 6.03c.3(i) of NAO 216-6, the proposed action to establish a framework process is a rulemaking of a purely administrative and procedural nature. Moreover, as described above, the proposed action would not contribute to impacts on the human environment. As such, it is categorically excluded from the need to prepare an Environmental Assessment or an Environmental Impact Statement.