



**NOAA
FISHERIES**

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Pacific mackerel (*Scomber japonicus*) stock assessment for USA management in the 2015-16 and 2016-17 fishing years



P. mackerel stock assessment (2015)

- Distribution and biology
- Data
 - Landings, biological compositions, indices of abundance
- Model
 - Model selection and evaluation
 - Important areas of sensitivity analysis (candidate models A-G, H1b)
- Results/diagnostics
 - Model H3
- Unresolved problems and major uncertainties
 - AT survey q uncertainty and population scale determination
- Future work
 - Field, laboratory, modeling, management



Distribution

Spawning Area

Fisheries

OR-WA

Monterey

San Pedro
San Diego

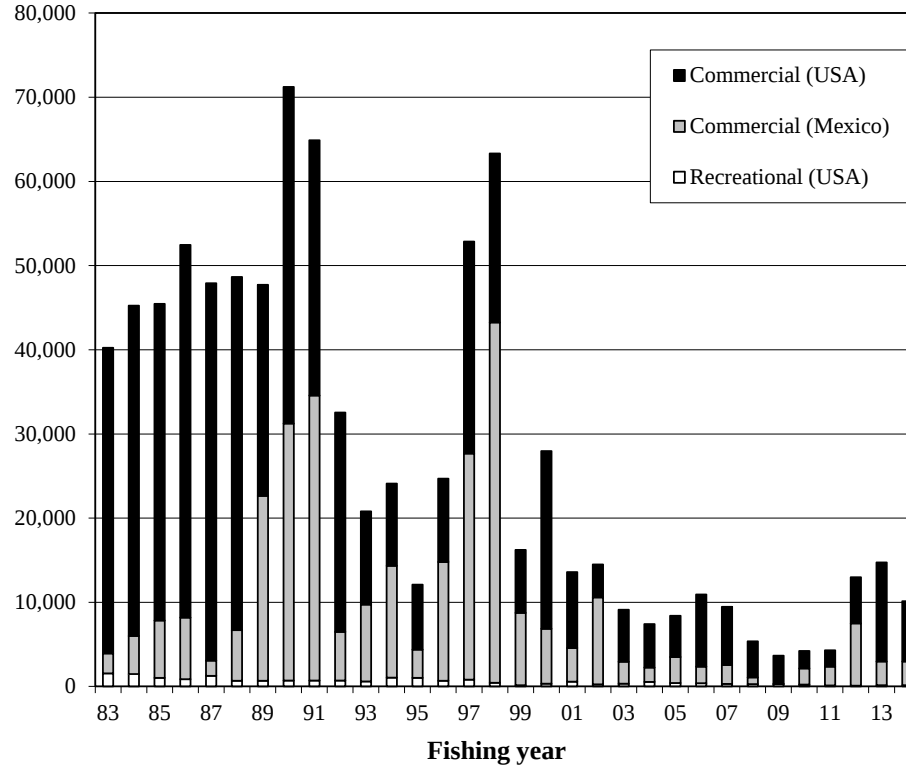
Ensenada

Bahia
Magdalena



P. mackerel landings

Landings (mt)



Fishing year	Commercial				Recreational	Total	Recreational
MX	CA	OR	WA	CA	Proportion		
2004	1,711.4	5,011.8	110.4	23.7	544.0	7,401.3	0.07
2005	3,084.9	4,572.1	314.3	22.3	412.0	8,405.5	0.05
2006	1,986.1	7,870.2	669.4	41.8	372.0	10,939.5	0.03
2007	2,218.4	6,208.4	697.8	37.5	310.4	9,472.5	0.03
2008	803.1	4,203.9	57.6	9.0	280.3	5,353.9	0.05
2009	49.4	3,278.7	54.4	4.9	268.6	3,656.0	0.07
2010	1,916.7	2,047.0	47.8	1.6	216.6	4,229.7	0.05
2011	2,232.0	1,665.2	201.9	83.0	127.0	4,309.0	0.03
2012	7,390.0	3,201.5	1,587.8	693.4	100.2	12,972.9	0.01
2013	2,825.2	11,165.3	437.9	178.5	139.9	14,746.9	0.01
2014	2,825.0	5,445.5	1,172.3	544.8	136.4	10,124.0	0.01
Avg. (2004-14)	2,458.4	4,970.0	486.5	149.1	264.3	8,328.3	0.04

P. mackerel stock assessment (2015)

Candidate models (A-G, H1b, H3) (see Table 5, p. 54)

DATA / PARAMETERIZATION		MODEL SCENARIO									
		XA	A	B	C	D	E	F	G	H1b	H3
Survey		CPFV+CRFS	CPFV+CRFS	CPFV	CPFV+AT	CPFV+AT	CPFV+AT	CPFV+AT	CPFV+AT	CPFV+AT(split)	CPFV
Fishery		COM+REC	COM+REC	COM+REC	COM+REC	COMBINED	COMBINED	COMBINED	COMBINED	COMBINED	COMBINED
Selectivity	Fishery	COM-A REC-D	COM-A REC-D	COM-A REC-A	COM-A REC-A	FISH-A	FISH-D	FISH-A	FISH-A	FISH-A	FISH-A
	Indices	CPFV/CRFS-D	CPFV/CRFS-D	CPFV-A	CPFV-A/AT-D	CPFV-A/AT-D	CPFV-A/AT-A	CPFV-A/AT-A	CPFV-A/AT-D	CPFV-A/AT-A	CPFV-A
Growth		EST	EST	EST	EST	EST	EST	WAA	EST	EST	EST
Time Period		83-11	83-15	83-15	83-15	83-15	83-15	83-15	95-15	83-15	83-15

DATA COMPONENT		XA	A	B	C	D	E	F	G	H1b	H3
FISHERY	Commercial catch										
	Recreational catch										
	Commercial age composition										
	Commercial mean length-at-age composition										
	Commercial emp. weight-at-age										
INDICES	CPFV index of abundance										
	CPFV length composition										
	CRFS index of abundance										
	CRFS non-CPFV length composition										
	AT index of abundance										
	AT length composition										

LIKELIHOODS	XA	A	B	C	D	E	F	G	H1b	H3
<i>CPFV index of abundance</i>	-0.622494	27.0786	27.3636	27.1963	27.2052	28.4164	19.7996	31.1689	24.8849	25.2581
<i>CRFS index of abundance</i>	-5.32432	-7.5561	---	---	---	---	---	---	---	---
<i>AT index of abundance</i>	---	---	---	26.9134	26.9273	24.2056	19.2057	23.2081	27.5819 / 9.13455	---
Index subtotal	-5.9468	19.5225	27.3636	54.1097	54.1325	52.6220	39.0053	54.3770	61.6013	25.2581
Commercial age composition	368.3380	534.0110	529.9040	533.6810	533.6620	532.8950	459.345	245.137	533.715	529.389
<i>CPFV length composition</i>	184.491	259.1890	261.4350	260.9990	261.0130	255.1550	---	107.052	160.409	159.405
<i>CRFS (non-CPFV) length composition</i>	57.1463	37.7251	---	---	---	---	---	---	---	---
<i>AT length composition</i>	---	---	---	58.3037	58.3192	64.4841	---	59.3077	40.3628 / 39.2636	---
Length composition subtotal	241.6373	296.9141	261.4350	319.3027	319.3322	319.6391	---	166.3597	240.0360	159.4050
Commercial length-at-age composition	232.3010	345.6270	342.8390	344.1160	344.1690	343.1900	---	170.0750	345.7190	345.3350
<i>Catch</i>	0.0000E+00	8.0373E-13	1.0388E-12	1.0776E-12	3.8717E-13	2.8084E-13	1.6471E-12	1.2080E-12	5.3064E-13	3.9597E-13
Recruitment	11.4081	17.1982	18.1270	16.9446	17.1770	16.8241	33.6658	5.1704	17.2991	18.1602
Forecast recruitment	0.2347	0.3616	0.1874	0.2634	0.1344	0.1657	0.0172	0.0952	0.0084	0.1644
Parm_softbounds	2.91E-03	5.24E-03	1.67E-03	3.45E-03	3.45E-03	3.53E-03	1.26E-04	1.62E-03	1.84E-03	1.68E-03
Total -log(L)	847.975	1213.640	1179.858	1268.421	1268.611	1265.339	532.033	641.216	1198.381	1077.713
Number of estimated parameters	57	60	50	57	57	56	46	45	54	51

ESTIMATED QUANTITIES	XA	A	B	C	D	E	F	G	H1b	H3
Ln(R0)	13.5383	13.2529	13.2075	13.2000	13.2053	13.3088	12.6307	12.2836	13.1679	13.1946
B-H Steepness	0.681454	0.465944	0.478568	0.473756	0.471256	0.434983	0.647027	0.631959	0.457402	0.475177
AT survey <i>q</i>	---	---	---	1.91	1.91	0.97	2.35	7.67	1.25 / 0.86	---
Stock Biomass - Peak	1,071,020	1,370,390	1,284,900	1,280,420	1,278,240	1,545,100	870,245	346,729	1,169,790	1,232,150
Stock Biomass - 2011	202,027	67,683	59,566	62,717	62,734	78,649	31,432	27,728	49,328	57,122
Stock Biomass - 2015	---	149,236	136,171	111,023	114,510	151,076	29,772	32,614	65,043	120,435
HG 2015-16	---	27,518	24,774	19,493	20,225	27,904	2,430	3,027	9,837	21,469

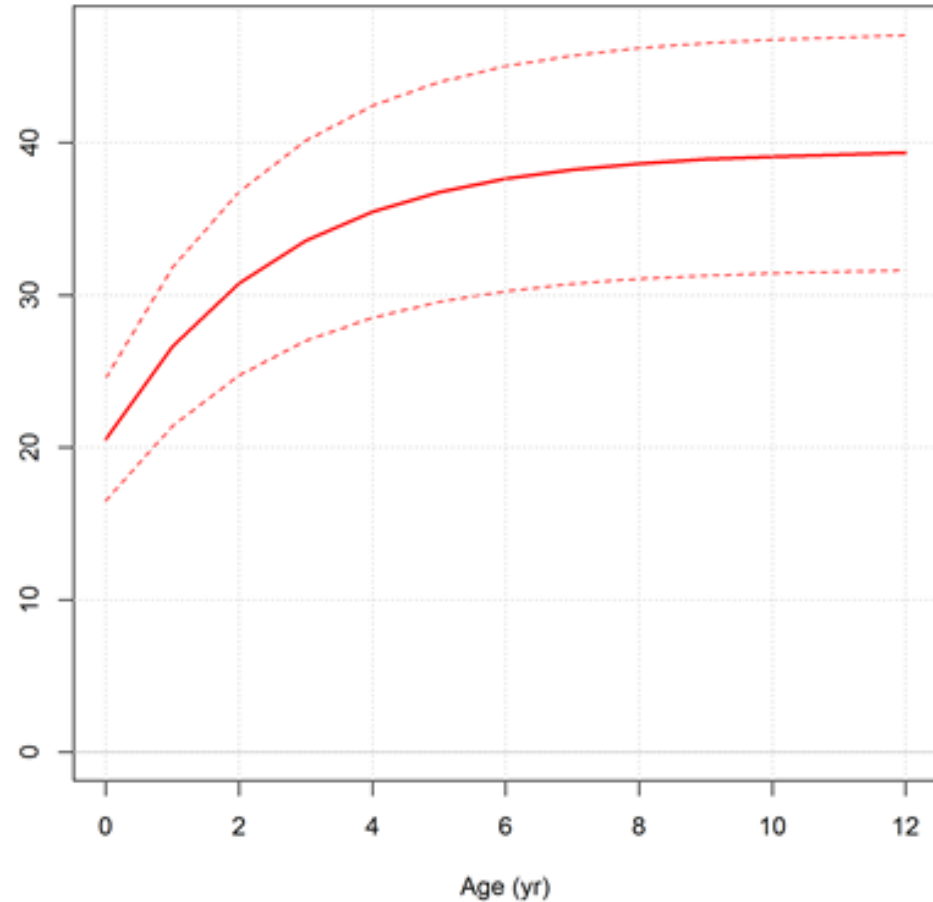
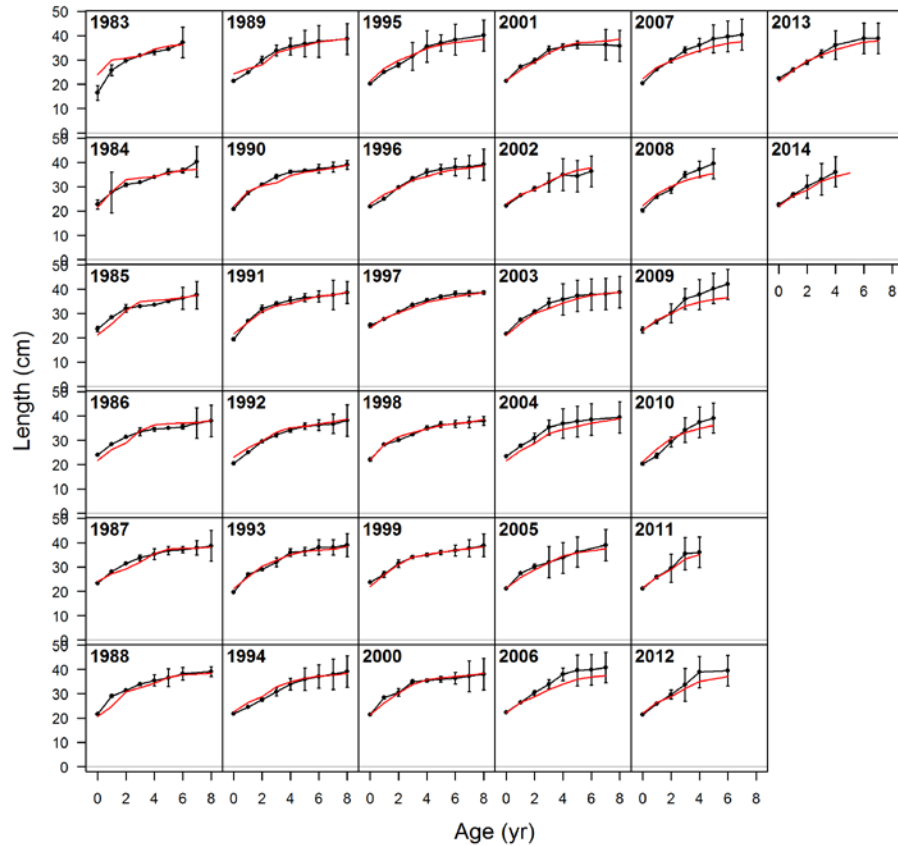
P. mackerel stock assessment (2015)

Model H3 – STAT's selected model

- Reflects an updated configuration that includes similar data and parameterizations as last accepted model for advising management
- Plausible configuration with reasonable fits to input time series
- Robust in most diagnostic investigations
- Results consistent with external information regarding stock size/availability, e.g., AT survey abundance index, unrealized quotas in USA, limited catches in Mexico
- Bottom-line results useful to management similar to model that included AT survey data

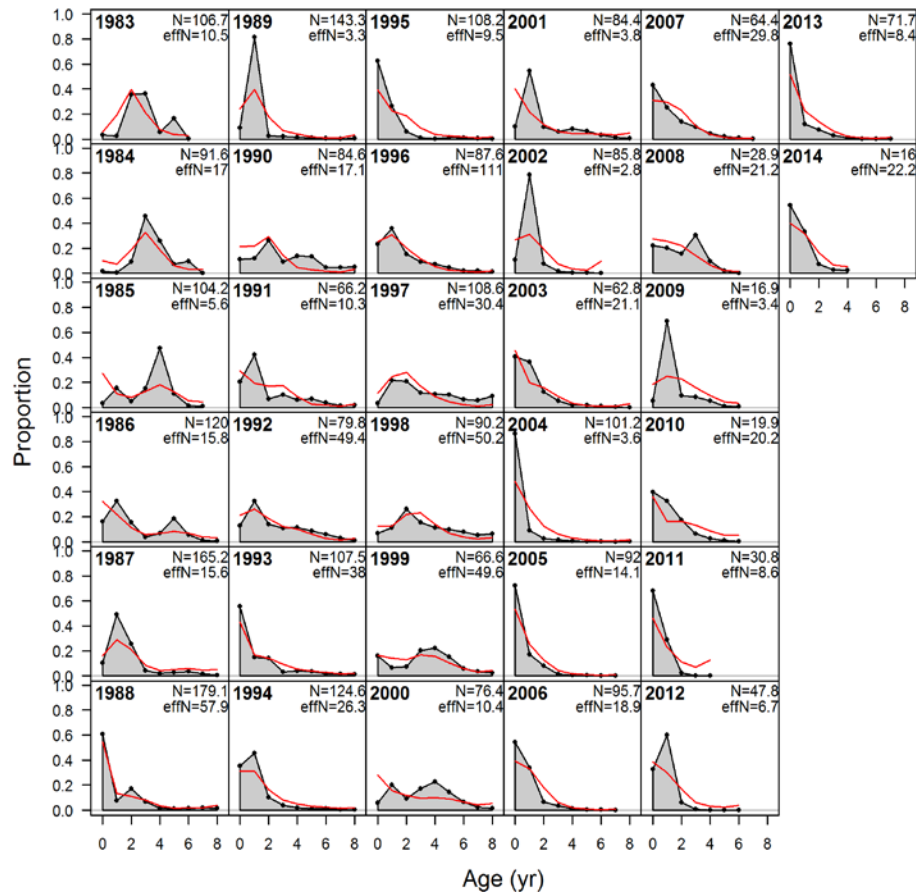
P. mackerel stock assessment (2015)

Model H3 – Fits to mean length-at-age data

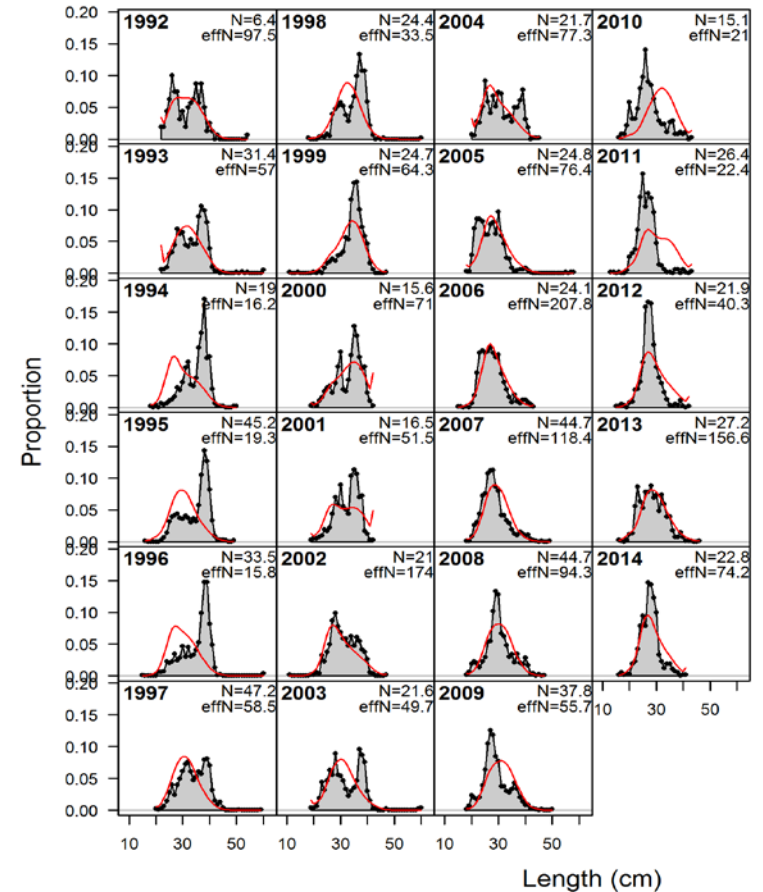


P. mackerel stock assessment (2015) – Model H3

CA comm. fishery age composition

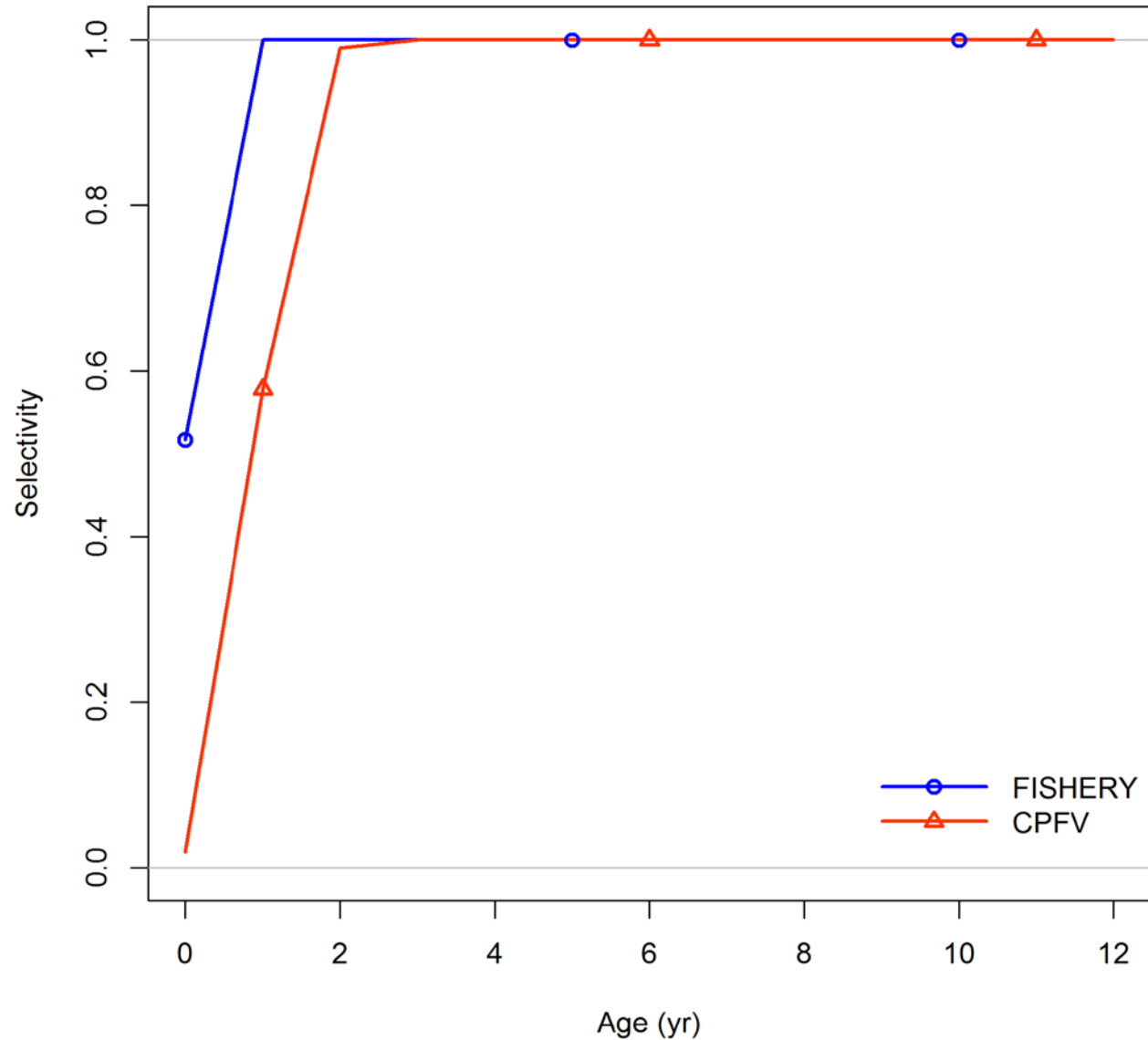


CPFV length composition



P. mackerel stock assessment (2015) - Results

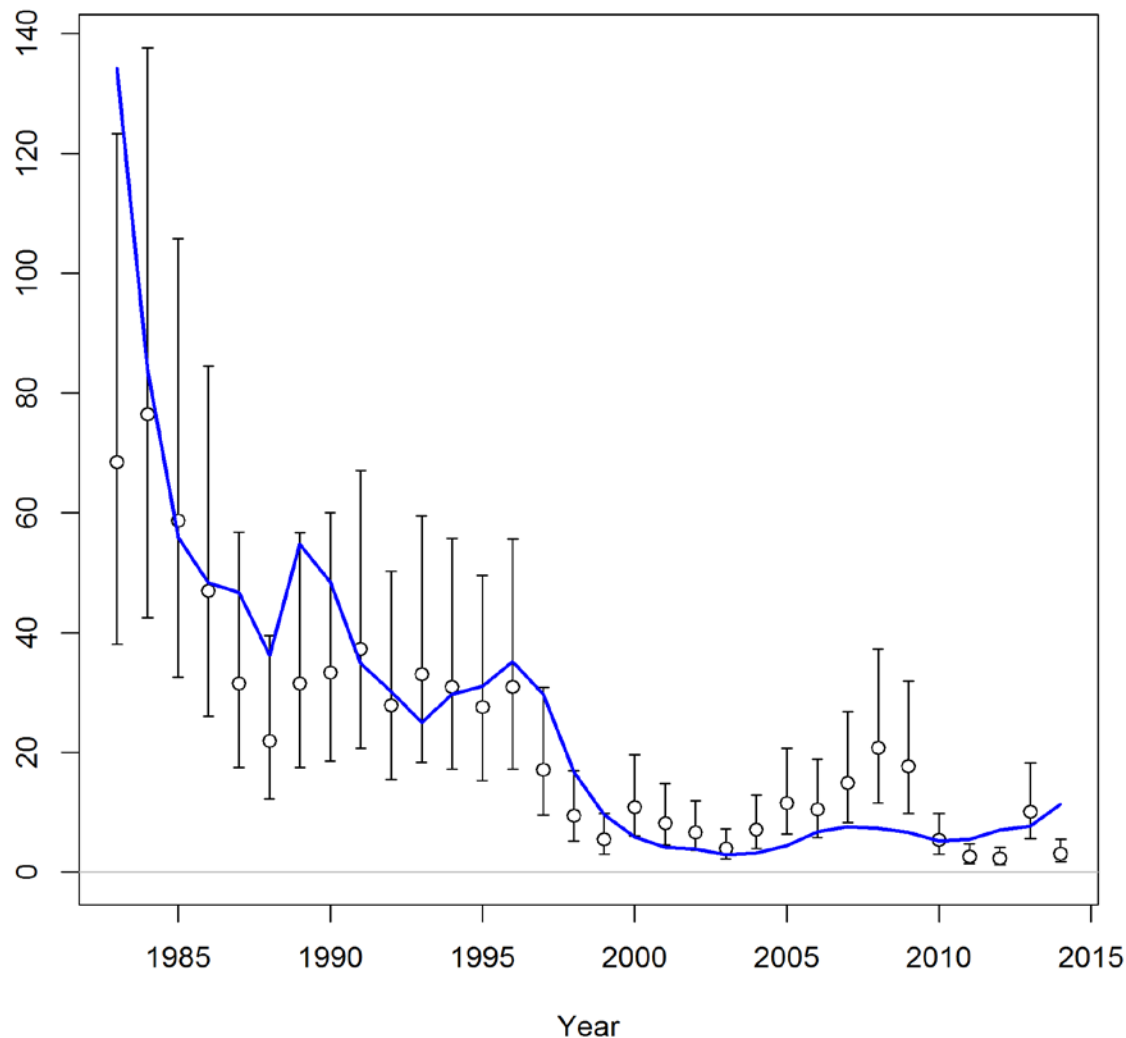
Model H3 – Selectivity



P. mackerel stock assessment (2015) - Results

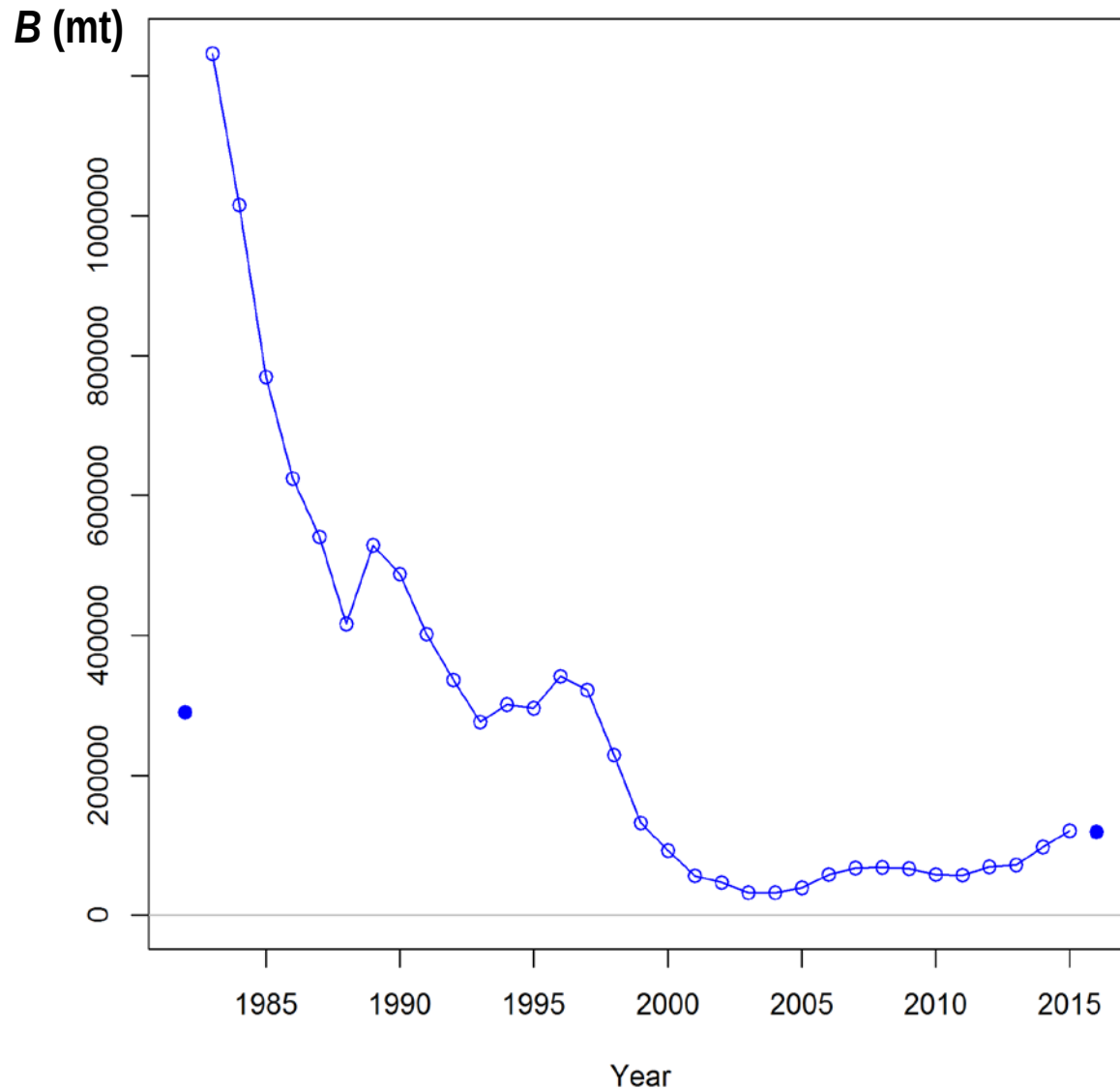
Model H3 – Fit to CPFV index of relative abundance

Std. est. (fish/1,000 ang. hr)



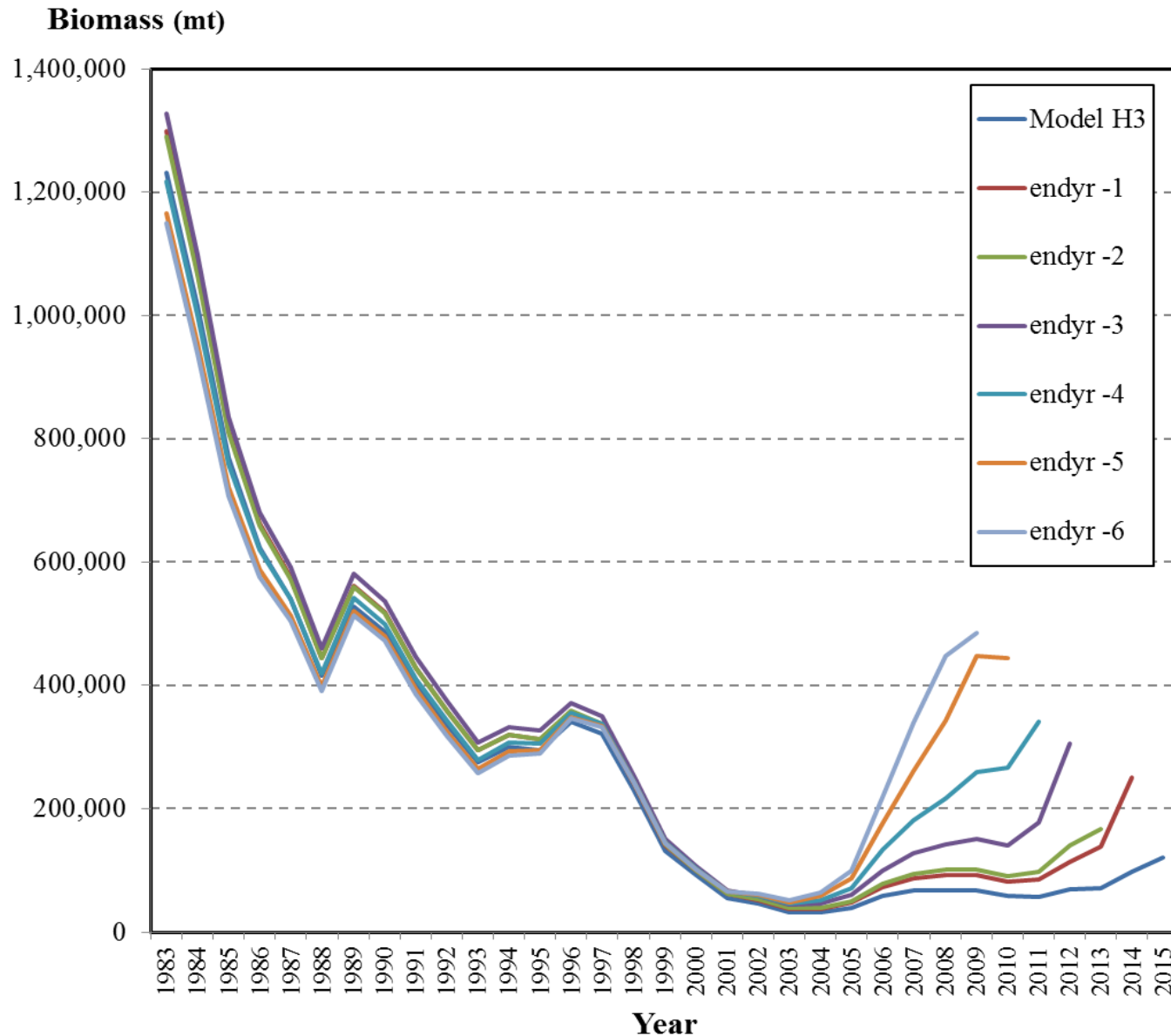
P. mackerel stock assessment (2015)

Model H3 – Stock biomass (age 1+ fish)



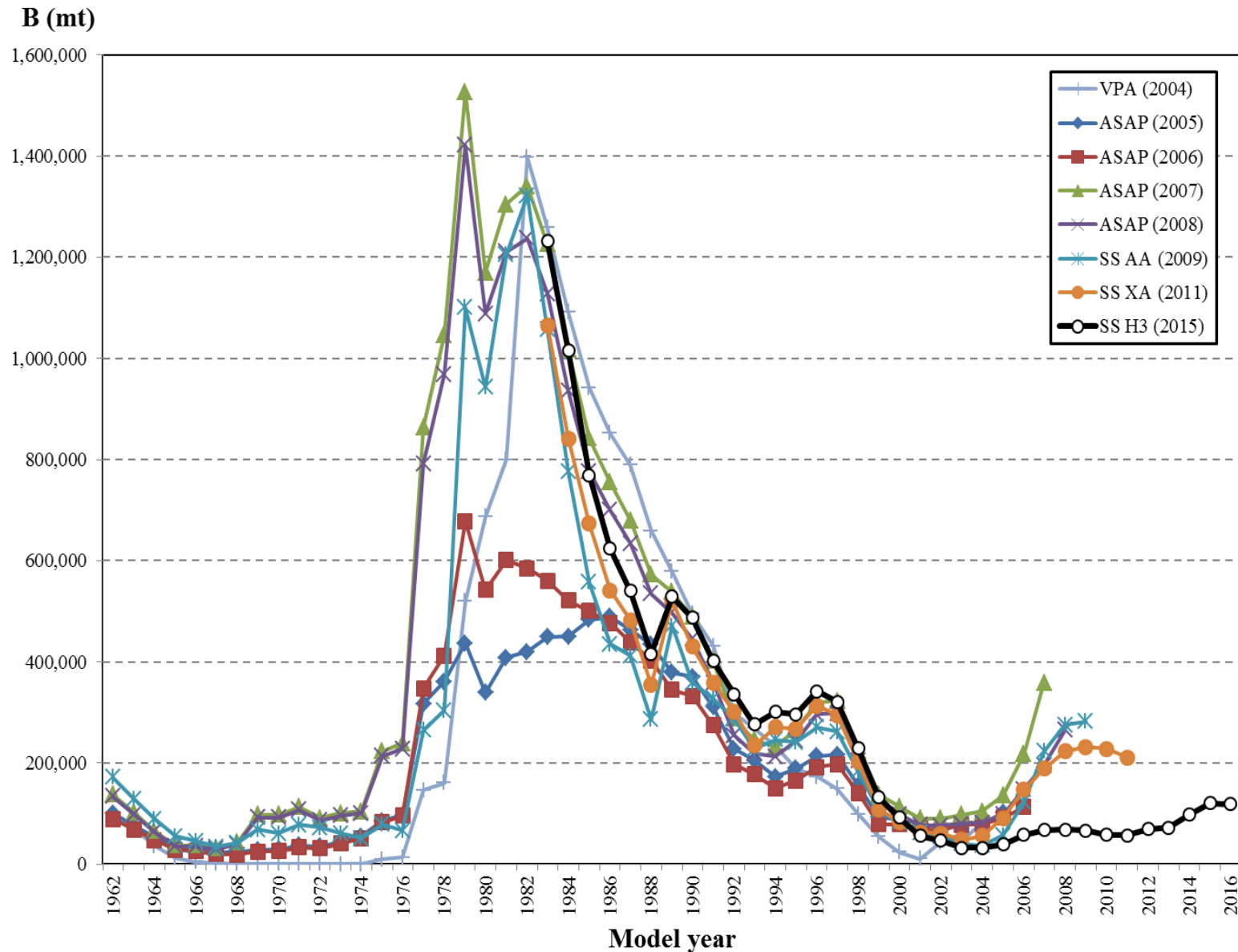
P. mackerel stock assessment (2015)

Model H3 – Retrospective analysis



P. mackerel stock assessment (2015)

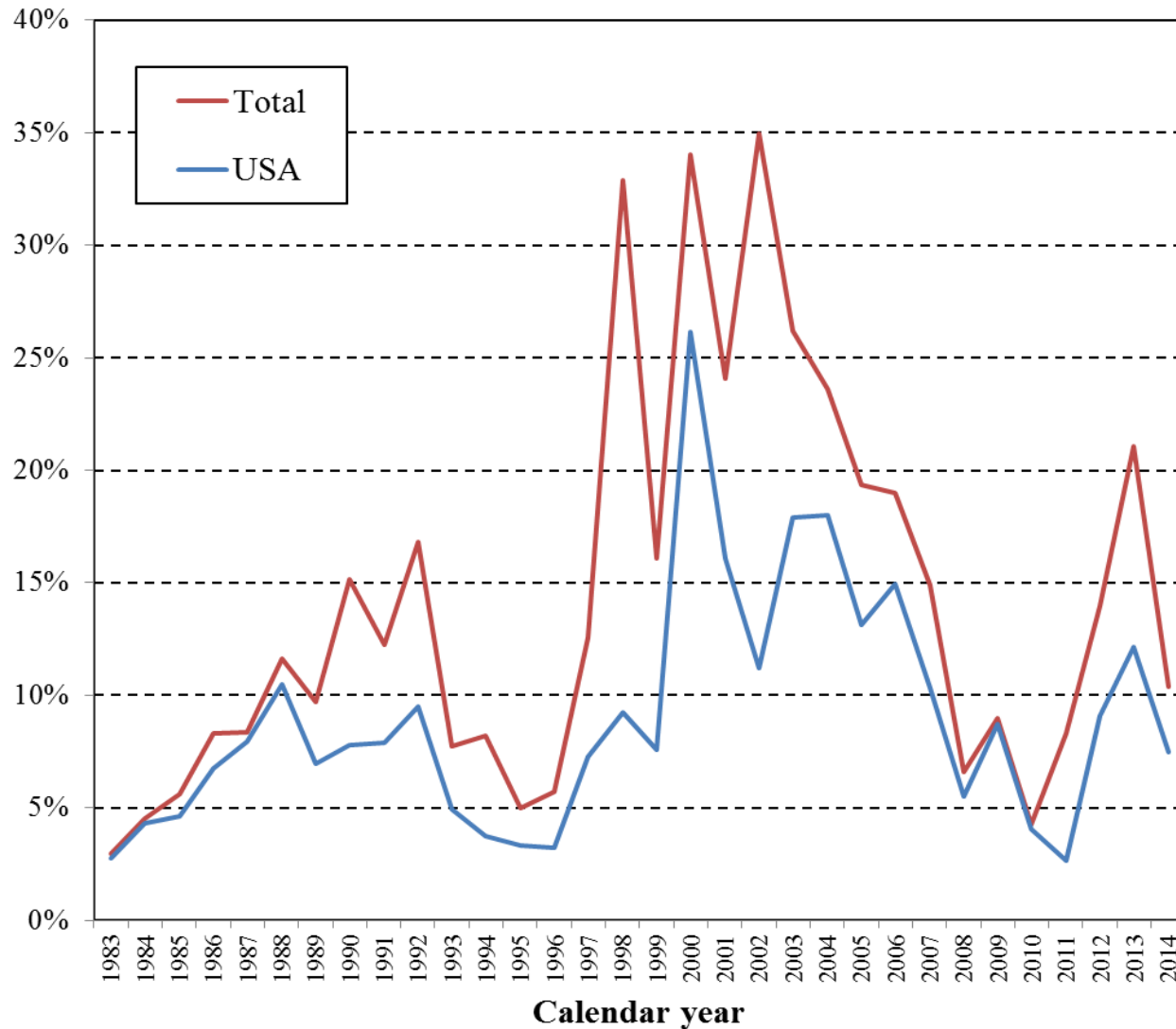
Model H3 – Historical stock biomass (age 1+ fish)



P. mackerel stock assessment (2015)

Model H3 – Total and USA exploitation rates

Exploitation
Rate



2015-16

Harvest Control Rule Formulas										
OFL = BIOMASS * E_{MSY} * DISTRIBUTION										
ABC _{P-star} = BIOMASS * BUFFER _{P-star} * E_{MSY} * DISTRIBUTION										
HG = (BIOMASS - CUTOFF) * E_{MSY} * DISTRIBUTION										
Harvest Formula Parameters										
BIOMASS (ages 1+, mt)	120,435									
P-star	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.10	0.05	
ABC Buffer _{Tier 1}	0.9558	0.9128	0.8705	0.8280	0.7844	0.7386	0.6886	0.6304	0.5531	
ABC Buffer _{Tier 2}	0.9135	0.8333	0.7577	0.6855	0.6153	0.5455	0.4741	0.3974	0.3060	
E_{MSY}	0.30									
CUTOFF (mt)	18,200									
DISTRIBUTION (U.S.)	0.70									
Harvest Control Rule Values (mt)										
OFL =	25,291									
ABC _{Tier 1} =	24,173	23,087	22,016	20,940	19,839	18,681	17,415	15,944	13,990	
ABC _{Tier 2} =	23,104	21,074	19,164	17,338	15,562	13,798	11,992	10,052	7,738	
HG =	21,469									

Harvest Control Rule Formulas										
OFL = BIOMASS * E_{MSY} * DISTRIBUTION										
ABC _{P-star} = BIOMASS * BUFFER _{P-star} * E_{MSY} * DISTRIBUTION										
HG = (BIOMASS - CUTOFF) * E_{MSY} * DISTRIBUTION										
Harvest Formula Parameters										
BIOMASS (ages 1+, mt)	118,968									
P-star	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.10	0.05	
ABC Buffer _{Tier 1}	0.9558	0.9128	0.8705	0.8280	0.7844	0.7386	0.6886	0.6304	0.5531	
ABC Buffer _{Tier 2}	0.9135	0.8333	0.7577	0.6855	0.6153	0.5455	0.4741	0.3974	0.3060	
E_{MSY}	0.30									
CUTOFF (mt)	18,200									
DISTRIBUTION (U.S.)	0.70									
Harvest Control Rule Values (mt)										
OFL =	24,983									
ABC _{Tier 1} =	23,878	22,805	21,747	20,685	19,597	18,453	17,203	15,750	13,819	
ABC _{Tier 2} =	22,822	20,817	18,930	17,127	15,372	13,629	11,846	9,929	7,644	
HG =	21,161									

2016-17

Research and Data Needs

- AT survey
 - Long-term support needed for monitoring small pelagic species assemblage
 - Expand survey area (address stock distribution assumptions)
 - Improve trawl sampling operations
- Model development
 - Develop a prior and plausible bounds for catchability coefficient (q)
 - Population scale (selectivity/robustness)
 - ❖ Selectivity: dome-shaped vs. asymptotic (fishery age compositions)
 - ❖ Age data from all fisheries/survey; more flexible selectivity forms, time-varying processes, data weighting schemes
- International relations
 - Survey collaboration, improve fishery data exchange
- Fishery/survey biological sampling
 - Pacific NW size/age data, AT survey age data, Mexico size/age data
 - Coordinated production ageing programs