Updated size composition data from the San Diego Commercial Passenger Fishing Vessel (CPFV) recreational fishery for Fleet 15: Eastern Pacific Ocean Sport Fisheries, 2014-2019

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Summary

The size composition data collected by the National Oceanic and Atmospheric Administration (NOAA) Pacific Bluefin Tuna Port Sampling Program is considered the best available data to represent the PBF caught recreationally in the Eastern Pacific Ocean Sport Fishery, Fleet 15, included in the ISC stock assessment (Lee et al., 2015). Due to inconsistent sampling prior to 2014 and a short time series after 2014, the size composition data for Fleet 15 have not been used to inform the fleet selectivity in previous stock assessments. This paper updates the size composition data representative of Fleet 15 by providing results from July 2014 to October 2019.

Introduction

Pacific bluefin tuna (*Thunnus orientalis*) (PBF) are landed in both U.S. commercial and recreational fisheries in the Eastern Pacific Ocean (EPO). While the US purse seine fishery (also known as Fleet 13 in the ISC stock assessment; ISC, 2018) historically landed large numbers of PBF, the fishery declined dramatically in the 1970s when U.S. commercial vessels were excluded from Mexican waters (Aires-da-Silva et al., 2007). Currently, the vast majority of PBF catch in the U.S. is landed from recreational fisheries including both private boaters and publicly chartered Commercial Passenger Fishing Vessels (CPFV). Together, these operations comprise Fleet 15, the Eastern Pacific Ocean Sport Fishery, included in the ISC stock assessment. The CPFV fleet dominates the catch totals for Fleet 15 and both short-range (≤ 3 days) and long-range (>3 days) trips target PBF year-round in U.S. and Mexican waters when fish are available and when U.S. vessels are permitted to target PBF in Mexico. In recent years, the CPFV fleet has caught more PBF and PBF of larger sizes. The forcing mechanisms underlying the variability in both fish size and availability in the EPO are not well understood. However, warmer waters associated with El Niño events—as occurred in 2015 and 2016—may result in a northward shift in distribution and increased availability in U.S. waters (Runcie et al., 2018). Along with private boat data surveyed by federal and state port sampling, catch totals reported in state-mandated CPFV logbooks are considered the best available data to represent PBF caught recreationally in Fleet 15 (Lee et al., 2015).

In addition to catch data, size composition data are important to stock assessments because they are used to inform model processes (e.g., estimating selectivity). Lengths measured from PBF caught on the CPFV trips operating out of San Diego, CA are considered the best available data to inform the size composition for Fleet 15 (Lee et al., 2015). San Diego has the largest

number of CPFV vessels targeting PBF on the U.S. West Coast and is positioned in the middle of the geographic range of PBF in the EPO, allowing for near year-round targeting of PBF. Length data for PBF brought into San Diego landings were collected by the Inter-American Tropical Tuna Commission (IATTC) from 1993 to 2012, but the program ended in 2012 and no data were collected in 2013. These size composition data were not used as a likelihood component in the 2014 stock assessment (ISC, 2014). In July 2014, the National Oceanic and Atmospheric Administration (NOAA) recommenced sampling of PBF lengths from the San Diego CPFV fleets through the NOAA Pacific Bluefin Sampling Program (Heberer et al., in prep., Lee et al., 2015). However, due to the short time series of size data from 2014 to 2016 at the time of the 2018 ISC stock assessment, the CPFV length data were not fit to estimate Fleet 15 selectivity. Fleet 15 selectivity was instead mirrored to Fleet 13 selectivity which uses historical size data from 1952 to 1982 from the U.S. commercial purse seine fishery. This assumes current catch for Fleet 15 target the same age classes of fish as historical Fleet 13 (ISC, 2018, Lee et al., 2015). Both the commercial purse seine catch and size composition data from nearly 30 years ago may not accurately reflect the catch, gear selectivity, nor the current population age of Fleet 15.

In this paper we present recreational catch totals, size sampling protocols, and the length data for PBF sampled from the San Diego CPFV fleet between July 2014 and October 2019 by the NOAA Pacific Bluefin Sampling Program.

Materials and Methods

Recreational catch totals in California

Total number of PBF kept by month and year was calculated as the sum of the PBF caught by California CPFV logbooks and private fleets between February 2014 and December 2018, the most recently available data. The data does not include the small numbers of PBF caught in Oregon, as catch from California represents more than 90% of the total catch from the U.S. West Coast for the purpose of calculating the percent measured. Private boat catch is based on an integrated state and federally funded sampling program (California Recreational Fisheries Survey, CRFS) conducted since January 2004, which sample the non-CPFV fishing trips at the locations where anglers complete trips. CPFV catch is based on self-reported and state mandated logbook data for each calendar year and can be assessed since 1985. The number of

PBF measured was divided by the number of PBF kept by month and by year since July 2014 to December 2018 to calculate the percent measured.

Recreational size data

Length data for PBF caught by the CPFV fleets based out of San Diego were sampled between July 2014 and October 2019. A comprehensive description of the NOAA Pacific Bluefin Sampling Program, the operations of the CPFV fleets, and size sampling methods are detailed in Heberer et al. (in prep). Briefly, a two-stage sampling design (Stage 1: trip, Stage 2: individual fish) was used to randomly sample whole PBF unloaded from short-range and long-range trips from the main sportfishing landings and fish processing facilities in San Diego, CA. Straight fork length (FL) from the closed mouth to the fork in the caudal fin was measured to the nearest millimeter for 40 fish per trip (2014-2015 seasons) or 30 fish per trip (2016-2019 seasons). The fish to be measured were determined by randomly selecting angler numbers from vessels prior to sampling. Trip metadata collected included: vessel name, trip type (short-range or long-range), trip length (number of days), departure date, return date, total PBF landed on the trip, and total PBF sampled on the trip. Monthly average FL and standard deviation were calculated by month and year. Lengths were binned into 1-cm bins for length frequency distribution and analysis.

Results

Sampling effort

A total of 4,593 PBF were measured from 337 trips on 45 unique vessels between July 2014 and October 2019. Sampling occurred at five distinct locations in the port of San Diego, with over 90% of lengths sampled from vessels at Fisherman's Landing (35.8%), Point Loma Sportfishing (32.9%), and H&M Landing (21.4%). Only one PBF was measured from a vessel from Seaforth Sportfishing, while the remaining 9.6% of PBF were measured at a local fish processing warehouse.

While the 2019 data is not yet available from CPFV logbooks, a total of 95,721 PBF were reported kept in 54 of the 60 months between January 2014 and December 2018. Months where non-zero catches of PBF varied within each calendar year, but all 12 calendar months were represented in aggregate catch totals and ranged from a low of 2 PBF in December 2015 to 13,973 in July 2014 (**Table 1**). From 2014-2018 a total of 3,911 PBF were measured from 269 trips on 39 unique vessels in 25 of the 54 months where PBF were reported caught. Size

composition data represented 4.0% of the total reported catch and 40.7% coverage of the possible sampling months. No PBF were measured in January, February, March, or December in all years, however, the combined catch in these months represented just 3% of the aggregate catch totals in 2014-2018 (**Figure 1**). Peaks in relative monthly sampling effort reflected corresponding peaks in relative monthly catch. More than 75% of the aggregate catch totals for 2014-2018 were caught in August (30.8% of catch total), July (27.7%), and September (18.1%) and more than 80% of the aggregate sampling totals for the same time period were collected in August (40.0% of sampling total), July (23.4%), and September (22.3%) (**Figure 1**). Size composition sampling represented 5.3% of aggregate August catch, 3.4% of aggregate July catch, and 5.0% of aggregate September catch.

Length compositions

The length frequency distribution for the 4,593 PBF sampled from San Diego from 2014-2019 was multimodal, which is expected when sampling a cohort of juveniles spending years foraging and growing in the EPO (**Figure 2**). Fork lengths ranged from 46.1 cm to 210.2 cm, with an average of 98.7 ± 26.8 cm FL. The overlap in the length ranges between ages is small enough that obvious modes are apparent for PBF of different size classes: 68 cm FL (age 1), 92 cm FL (age 2), 122 cm FL (age 3), and two smaller modes of 151 cm FL (age 4) and 173 cm FL (age 5) according to the age-length-weight relationship derived from the von Bertnalanffy growth curve and length-weight relationship used in the 2018 ISC stock assessment (ISC, 2018).

2014 Season

A total of 1,732 PBF were measured from 74 unique trips on 39 unique vessels between July and September of 2014. Sampling occurred in 3 of the 10 months where PBF were reported kept in CPFV logbook data, representing 30% coverage of the possible sampling months and 6.2% of the 2015 reported catch (range 4.5- 15.2% of monthly catch). Trip length information collected dockside showed 288 PBF were sampled from LR trips (16.6% of seasonal totals), 10 PBF from SR trips (0.5%), and 1,434 (82.7%) from trips of unknown duration. Fork lengths ranged from 57.7- 143.3 cm, with an overall average FL of 88.3 ± 17.3 cm.

2015 Season

A total of 493 PBF were measured from 32 trips on 26 unique vessels between June and September of 2015. Sampling occurred in 4 of the 12 months were PBF were reported kept in

CPFV logbook data, representing 33.3% coverage of the possible sampling months and 1.7% the 2014 reported catch (range 1.3- 3.2% of monthly catch). Trip length information showed 259 PBF were sampled from LR trips (52.5% of seasonal totals) and 234 PBF from SR trips (47.4%). Fork lengths ranged from 56.0 to 165.1 cm, with an overall average FL of 87.4 ± 15.7 cm.

2016 Season

A total of 769 PBF were measured from 65 trips on 57 unique vessels between April and September of 2016. Sampling occurred in 6 of the 9 months were PBF were reported kept in CPFV logbook data, representing 66.6% coverage of the possible sampling months and 6.2% of the 2016 reported catch (range 0.8- 12.9% of the monthly catches). Trip length information showed 288 PBF were sampled from LR trips (37.1% of seasonal totals) and 481 PBF from SR trips (62.0%). Fork lengths ranged from 60.5 cm to 184.3 cm, with an overall average FL of 106.8 ± 21.6 cm.

2017 Season

A total of 347 PBF were measured from 45 trips on 42 unique vessels between May and September and November to December of 2017. Sampling occurred in 7 of the 11 months where PBF were reported kept in CPFV logbook data, representing 63.6% coverage of the possible sampling months and 2.1% of the 2017 reported catch (0.5- 3.7% of the monthly catch). Trip length information showed 166 PBF were sampled from LR trips (47.5 % of seasonal totals), 179 PBF from SR trips (51.5%), and 2 PBF from trips of unknown duration (0.5%). Fork lengths ranged from 46.1 cm to 210.2 cm FL, with an overall average FL of 106.7 ± 36.3 cm.

2018 Season

A total of 570 PBF were measured from 53 trips from 42 unique vessels between June and August and November and December of 2018. Sampling occurred in 5 of the 12 months were PBF were reported kept in CPFV logbook data, representing 41.6% coverage of the possible sampling months and 5.4% of the yearly catch (range 3.3- 15.1% of the monthly catch). Trip length information showed 158 PBF were sampled from LR trips (27.7 % of seasonal totals), 393 PBF from SR trips (68.9%), and 19 PBF from trips of unknown duration (3.3%). Fork lengths ranged from 59.9 cm to 193.1 cm, with an overall average FL of 119.1 ± 39.4 cm.

2019 Season

A total of 682 PBF were measured from 68 trips from 49 unique vessels between May and October 2019. While CPFV logbook data is not yet available for the 2019 calendar year, sampling occurred in all 5 months during this time period. Trip length information showed 211 PBF were sampled from LR trips (30.8 % of seasonal totals), 451 PBF from SR trips (65.9%), and 20 PBF from trips of unknown duration (2.9%). Fork lengths ranged from 58.2 cm to 193.2 cm, with an overall average FL of 103.4 ± 23.6 cm.

Table 1. PBF catch and size composition data for 2014-2019. Listed months reflect logbook months with non-zero PBF catches.

Calendar Year	Month	PBF catch in CA	Total PBF measured (% of catch)	PBF measured by trip duration (% of total measured)			Avg. FL ± SD (cm)	Trips Sampled	Unique Vessels Sampled
				Long-range (>3 days)	Short-range (≤ 3 days)	Unknown			
2014	2	16	0	--	--	--	--	--	--
2014	3	3	0	--	--	--	--	--	--
2014	5	822	0	--	--	--	--	--	--
2014	6	599	0	--	--	--	--	--	--
2014	7	13,973	631 (4.5%)	10 (1.5%)	170 (26.9%)	451 (71.4%)	86.3 ± 15.1	29	16
2014	8	7,788	649 (8.3%)	--	59 (9.0%)	590 (90.9%)	93.3 ± 20.8	29	13
2014	9	2,964	452 (15.2%)	--	59 (13.0%)	393 (86.9%)	83.8 ± 12.0	16	10
2014	10	1,182	0	--	--	--	--	--	--
2014	11	468	0	--	--	--	--	--	--
2014	12	39	0	--	--	--	--	--	--
2014	Total	27,854	1,732 (6.2%)	288 (16.6%)	10 (0.5%)	1,434 (82.7%)	88.3 ± 17.3	74	39
2015	1	440	0	--	--	--	--	--	--
2015	2	268	0	--	--	--	--	--	--
2015	3	20	0	--	--	--	--	--	--
2015	4	11	0	--	--	--	--	--	--
2015	5	815	0	--	--	--	--	--	--
2015	6	1,420	46 (3.2%)	6 (13.0%)	40 (86.9%)	0	85.9 ± 7.2	3	2
2015	7	9,092	132 (1.4%)	81 (61.3%)	51 (38.6%)	0	95.8 ± 21.0	13	9
2015	8	10,433	234 (2.2%)	106 (45.2%)	128 (54.7%)	0	86.5 ± 11.9	11	10
2015	9	5,930	81 (1.3%)	66 (81.4%)	15 (18.5%)	0	77.2 ± 11.4	5	5
2015	10	173	0	--	--	--	--	--	--
2015	11	53	0	--	--	--	--	--	--
2015	12	2	0	--	--	--	--	--	--
2015	Total	28,657	493 (1.7%)	259 (52.5%)	234 (47.4%)	0	87.45 ± 15.7	32	26
2016	4	818	7 (0.8%)	0	7 (100%)	0	77.6 ± 3.0	3	3
2016	5	457	59 (12.9%)	0	57 (96.6%)	2 (3.3%)	86.4 ± 12.4	7	7

2016	6	1,005	65 (6.4%)	27 (41.5%)	34 (52.3%)	4 (6.1%)	120.7 ± 17.7	9	9
2016	7	1,156	72 (6.2%)	0	72 (100%)	0	116.8 ± 20.8	9	6
2016	8	3,597	355 (9.8%)	164 (46.1%)	191 (53.8%)	0	98.7 ± 21.6	23	19
2016	9	3,264	217 (6.6%)	97 (44.7%)	120 (55.2%)	0	119.1 ± 11.8	14	13
2016	10	553	0	--	--	--	--	--	--
2016	11	1,288	0	--	--	--	--	--	--
2016	12	176	0	--	--	--	--	--	--
2016	Total	12,314	769 (6.2%)	288 (37.1%)	481 (62.0%)	0	106.7 ± 21.6	65	57
2017	2	1	0	--	--	--	--	--	--
2017	3	52	0	--	--	--	--	--	--
2017	4	491	0	--	--	--	--	--	--
2017	5	791	30 (3.7%)	0	30 (100%)	0	150.7 ± 6.4	1	1
2017	6	378	11 (2.9%)	7 (63.6%)	4 (36.3%)	0	106.6 ± 29.6	5	5
2017	7	596	3 (0.5%)	0	3 (100%)	0	146.8 ± 20.8	2	2
2017	8	5,214	140 (2.6%)	80 (57.1%)	60 (42.8%)	0	89.4 ± 33.8	14	14
2017	9	3753	127 (3.3%)	79 (62.2%)	46 (36.2%)	2	121.7 ± 31.6	18	15
2017	10	1,718	--	--	--	--	--	--	--
2017	11	2,054	18 (1.0%)	0	18 (100%)	0	92.3 ± 14.8	2	2
2017	12	1,442	20 (0.9%)	0	20 (100%)	0	73.9 ± 4.2	3	3
2017	Total	16,490	347 (2.1%)	166 (47.5%)	179 (51.5%)	2 (0.5%)	106.7 ± 36.3	45	42
2018	1	326	0	--	--	--	--	--	--
2018	2	50	0	--	--	--	--	--	--
2018	3	86	0	--	--	--	--	--	--
2018	4	225	0	--	--	--	--	--	--
2018	5	259	0	--	--	--	--	--	--
2018	6	1,434	48 (3.3%)	4 (8.3%)	44 (91.6%)	0	96.2 ± 17.2	9	9
2018	7	1778	82 (4.6%)	22 (26.8%)	41 (50%)	19 (23.1%)	119.8 ± 36.8	12	11
2018	8	2479	192 (7.7%)	49 (25.5%)	143 (74.4%)	0	126.6 ± 48.2	20	14
2018	9	1492	0	--	--	--	--	--	--
2018	10	807	30 (3.7%)	30 (100%)	0	0	106.0 ± 13.2	1	1

2018	11	1439	218 (15.1%)	53 (24.3%)	165 (75.6%)	0	118.9 ± 35.4	11	7
2018	12	31	0	--	--	--	--	--	--
2018	Total	10,406	570 (5.4%)	158 (27.7%)	393 (68.9%)	19 (3.3%)	119.1 ± 39.4	53	42
2014-2018	**Totals**	**95,721**	**3,911 (4.0%)**	**1,159 (29.6%)**	**1,297 (33.1%)**	**1,455 (37.2%)**	**97.9 ± 27.2**	**269**	**39**
2019	5	--	9	0	9 (100%)	0	116.7 ± 3.0	3	3
2019	6	--	189	37 (19.5%)	152 (80.4%)	0	116.6 ± 15.9	20	14
2019	7	--	92	59 (62.7%)	33 (35.1%)	2 (2.1%)	100.3 ± 19.2	11	9
2019	8	--	293	38 (12.9%)	237 (80.8%)	18 (6.1%)	95.2 ± 25.9	27	16
2019	9	--	61	41 (67.2%)	20 (32.7%)	0	98.5 ± 19.7	4	4
2019	10	--	38	36 (94.7%)	0	2 (5.2%)	111.3 ± 22.3	3	3
2019	Total	--	682	211 (30.9%)	451 (66.1%)	20 (2.9%)	103.4 ± 23.6	68	49
2014- 2019	**Totals**	**--**	**4,593 (--)**	**1,370 (29.7%)**	**1,748 (38.0%)**	**1,475 (32.1%)**	**98.7 ± 26.8**	**337**	**45**

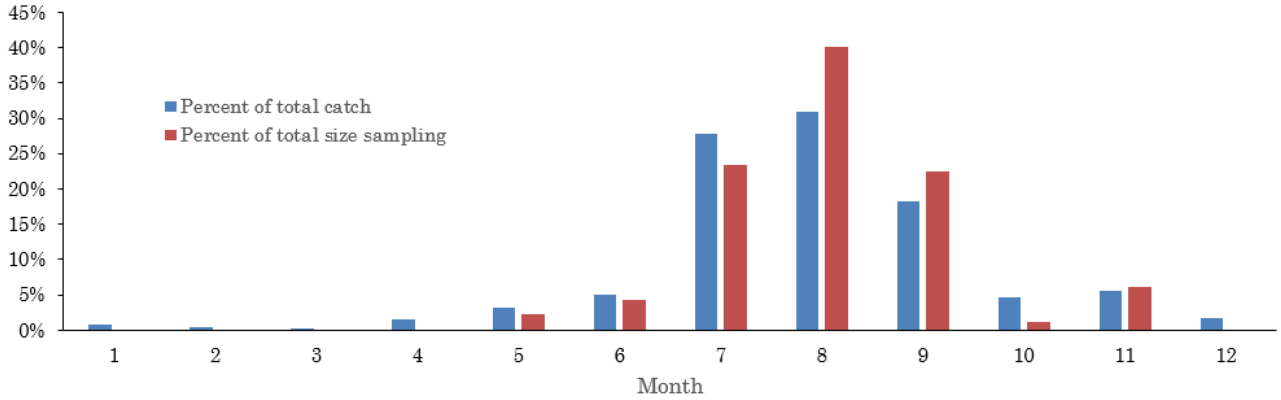

Figure 1. Monthly catch as percentage of aggregate 2014-2018 catch (blue) and monthly size composition sampling as percentage of aggregate 2014-2018 size composition sampling (orange). Peaks in size composition sampling effort reflected peaks in catch, notably in August (8), July (7), and September (9).

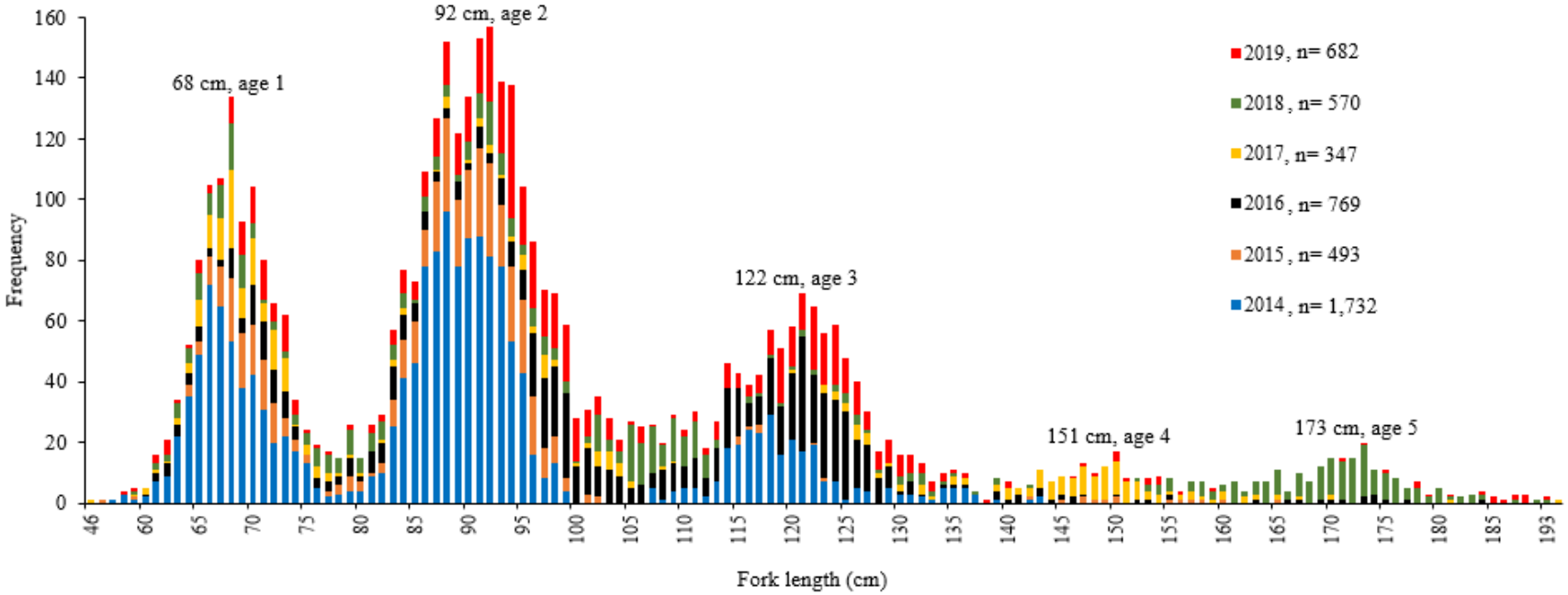

Figure 2. Frequency distribution (1-cm bins), modes, and corresponding age classes (ISC, 2018) of the 4,593 PBF lengths measured between July 2014 and October 2019 by the NOAA Pacific Bluefin Tuna Port Sampling Program.

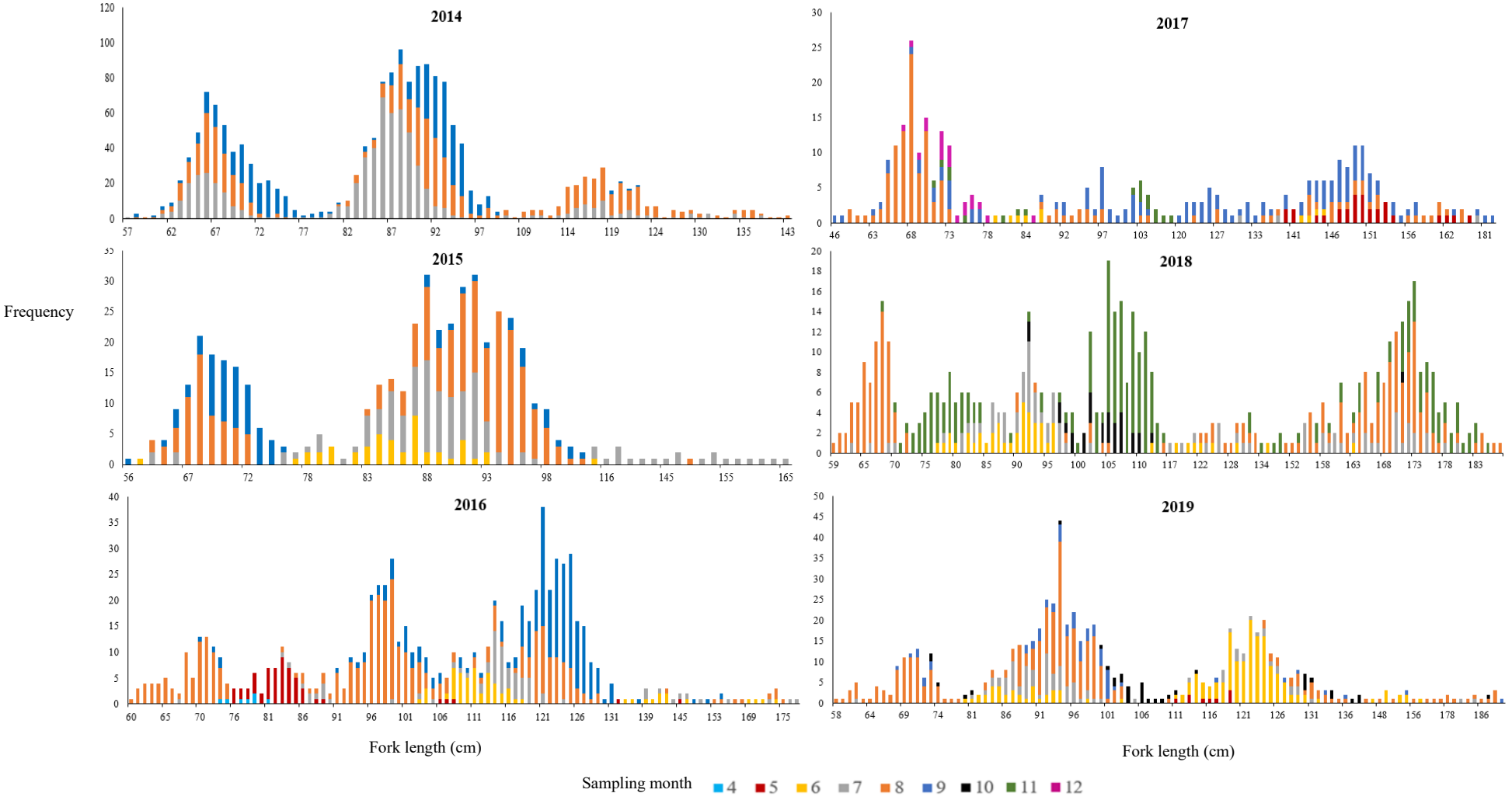

Figure 3. Frequency distribution of PBF fork lengths sampled by month by year.

Discussion

The National Oceanic and Atmospheric Administration (NOAA) Pacific Bluefin Tuna Port Sampling Program since 2014 has measured about 2-6% of PBF kept in California yearly. The size caught were from age 1 to age 5 given the age-length relationship and size distributions. Using the same selection pattern from the historical US commercial fleets to represent the recreational fleet may not be appropriate due to the increased abundance and larger fish caught in recent years. We recommend that the assumption of borrowing selectivity should be revisited.

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