Size and age information for Mutton Snapper, *Lutjanus analis*, collected in association with fishery-dependent monitoring along Florida's coast

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Introduction:

The Fishery Dependent Monitoring subsection (FDM) of the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute (FWRI) uses several fishery-dependent research and monitoring projects to monitor commercial and recreational fishing in marine environments along the Florida coast. FDM administers two federal surveys, the Marine Recreational Information Program (MRIP) for the recreational sector and the Trip Interview Program (TIP) for the commercial sector. Additionally, FDM conducts several unique recreational angler surveys that allow for the collection of supplemental biological data. Each fishery dependent research or monitoring project that contributed to the age and length data provided to the Life History Group is described below. Because fish must be returned to anglers quickly during fishery-dependent surveys, priority was given to collecting the left otolith if both otoliths could not be removed.

For all fleets and surveys, fish were geographically grouped based on statistical zone, or landing county if statistical zone was unavailable. Fish for which statistical zone was 7-10 (Escambia – Dixie counties) were coded as northwest Florida (NWFL). Fish for which statistical zone was 3-6 (Levy - Collier counties) were coded as southwest FL (SWFL). All fish caught/landed in Monroe County were coded as Florida Keys (KEYS). Fish for which statistical zone was 736-744 (Indian River – Miami-Dade counties) were coded as Southeast Florida (SEFL). Fish for which statistical zone was 722-732 (Nassau – Brevard counties) were coded as Northeast Florida (NEFL).

Commercial Fishery Data

Trip Interview Program (TIP)

The commercial fishery is sampled via the NOAA Trip Interview Program (TIP) in which Florida participates. Biological samples collected from the commercial fishery included in this dataset include the years 2000-2020. The primary focus of the TIP program is collecting random size frequency data and biological samples from commercial marine species. Samplers take information from harvested fish being offloaded from commercial fishing vessels. Length measurements include fork length and natural total length (mm). Weight measurements are

whole weight or gutted weight (kg), dependent upon on the status of the fish upon landing. Typically, a single otolith is extracted below the operculum to maintain filet integrity. Length and weight data are provided as part of a single federal dataset. Otoliths are aged with samples collected from recreational fisheries by FWRI Age and Growth Laboratory and are provided with the current dataset. Commercial sampling was minimally impacted by the COVID-19 pandemic, with sampling halted only from April 2 to May 5, 2020.

Recreational Fishery Data

At-Sea Observer Sampling of For-Hire Fisheries

Age and length information included here were collected from at-sea observer surveys between 2005 and 2020. No sampling occurred between April 2020 and May 2021 due to the COVID-19 pandemic.

Gulf Coast of Florida (NWFL, SWFL)

Headboat observer surveys were conducted on the Gulf coast of Florida from 2005 to 2007, funded by the Gulf Fisheries Information Network (GulfFIN). In June 2009, the state of Florida secured alternative funds to continue at-sea observer coverage in the northwest panhandle and central peninsula and expanded coverage to include the charter fleet. In the year 2014, data from headboats and charter vessels in NWFL and SWFL were a small subset of the sampled for-hire fleet and may not be representative of the fleet as a whole in that year.

Florida Keys (KEYS)

Headboat observer surveys were conducted in the Florida Keys from 2005 to 2007, funded by the Gulf Fisheries Information Network (GulfFIN) along with the Gulf coast. In 2010, headboat sampling coverage in the Florida Keys was re-initiated, along with the initiation of charter boat sampling. In 2014, representative at-sea observer data was only collected from charter vessels in the Florida Keys.

South Atlantic coast of Florida (NEFL, SEFL)

On the South Atlantic coast, at-sea headboat sampling has been conducted continuously since 2004 funded by the Atlantic Coast Cooperative Statistic Program (ACCSP), with this report including data collected between 2005 and 2020. At-sea sampling on Atlantic coast charter boats was funded with a 3-year MARFIN grant from 2013-2015.

For at-sea surveys, headboats and charter boats were randomly selected weekly throughout the year in regional, fleet-specific draws. Biological data was collected dockside from harvested Mutton Snapper after an observed trip, including midline length (mm) and whole weight (kg). The left otolith was extracted from sampled fish when possible. Measurements and otoliths collected from observer coverage represent supplemental sampling separate of the dockside sampling conducted for the Southeast Regional Headboat Survey (SRHS).

State Reef Fish Survey of recreational fishers

The State Reef Fish Survey has run continuously on the Florida Gulf coast since May 2015, with the exception of a short dockside sampling hiatus at the height of the COVID-19 pandemic between March and mid-May 2020. This survey is a directed effort to collect data from offshore private recreational anglers who target reef fish species. Anglers wishing to harvest certain reef fish species, including Mutton Snapper, on the Gulf or Atlantic coasts of Florida are required to have a State Reef Fish Angler designation on their fishing license. The State Reef Fish Survey is composed of two survey components: a mail survey of State Reef Fish anglers, which collects data on angler effort, and a dockside intercept survey, which collects data on angler catches and fishing practices. Interview assignments are drawn from a subset of sampling sites known to have offshore fishing activity to intercept fishers that target reef fish. The dockside interview includes biological sampling of reef fish species, including measurement of midline length (in mm) and whole weight (in kg). Otoliths are also taken during dockside sampling for retained fish.

Opportunistic Biological Sampling

Between 2000 and 2018 opportunistic biological sampling was conducted at angler intercept sites along the Gulf coast of Florida, supported by a limited amount of funding from GulfFIN. Sampling assignments were conducted opportunistically to maximize the number of biological samples collected, primarily from busy charter landing sites. While the sampling sites were not selected using a randomized methodology, the fish sampled were not sampled in a biased manner. Biological sampling of intercepted fish included collection of length measurements

(midline length in mm), whole weight (in kg) and collection of aging structures (otoliths or spines).

Representative Biological Sampling Program

The Representative Biological (RepBio) sampling program conducts supplemental biological sampling along the Gulf coast of the Florida peninsula (Escambia to Collier County) and the Florida Keys (Monroe). The survey began a pilot phase in 2018 and was fully implemented in January of 2019, along the Gulf coast of Florida. A randomized draw process is used to ensure representative collection of biological samples, along with a species list that prioritizes collection of biological samples from data-poor, state-managed, and federally managed species when encountered. Interviews of recreational anglers are conducted at fishing access points identified via the MRIP Site Register and assigned via a weekly draw by sub-region. Biological sampling of harvested species includes collection of length measurements (midline length in mm), whole weight (in kg) and collection of aging structures (otoliths or spines).

Ageing Protocols:

Sagittal otoliths were removed from the head, cleaned, dried, and stored in vials. The left otolith was processed for age determination unless it was broken through the core, in which case the right otolith was processed. The core of the otolith was marked with pencil and the whole otolith was mounted on card stock using hot glue. Otoliths were processed on a Buehler Isomet low speed saw that was equipped with four equally spaced diamond wafering blades. With this multi-blade technique, one transverse cut yields three ~400μm thick sections that encompass both the core and the entire region surrounding the core (VanderKooy et al. 2020). After processing, sections were mounted on glass slides with Flo-texx, a chemical mounting medium.

Sectioned otoliths were examined on a stereo microscope using either reflected or transmitted light, which was at the reader's discretion. Each otolith was examined with at least two blind reads. These reads were conducted either by two readers working independently, or by a single reader examining the otolith two separate times. When age estimates did not agree between reads, a third read was conducted to resolve the discrepancy. Ageing was conducted on the dorsal lobe of the otolith along an axis near the sulcal groove from the core to the edge.

Annual ages were calculated using annulus count (number of opaque zones), degree of marginal completion, average date of otolith increment deposition, and date of capture. This traditional method is based on a calendar year instead of time since spawning (VanderKooy et al. 2020). Previous studies of Mutton Snapper off the east coast of Florida determined that annulus formation occurs between February and June, with a peak from March through May (Burton 2002; Faunce et al. 2008). Using these criteria, age was advanced by one year if a large translucent zone was visible on the margin and the capture date was between January 1 and June 30. For all fish collected after June 30, age was assigned to be annulus count, since opaque zone formation is typically complete (Burton 2002). Calendar ages were converted to fractional, or monthly biological, ages by adding or subtracting the fraction of a year calculated between the assumed April 1 birth date and month of capture.

Given the timespan of otolith collections and turnover in the FWRI ageing lab, seven individual readers contributed to ageing these otoliths. Prior to ageing these samples, each ager read through an in-house reference set of Mutton Snapper otoliths representing a range of age classes, seasons, sexes and collection locations (Campana 2001) to calibrate ageing technique, particularly identification and interpretation of the first annulus and margin type. Quality control subsets were read each sampling year by all active readers to estimate precision. Readers were assigned different portions of the collections for individual reading. The average percent error on all first and second reads was 0.99%, which is considered highly precise (Campana 2001); moreover, there was an 90% age agreement between all first and second reads, and a 99% agreement +/- 1 year All age data provided for SEDAR79 included increment count, calendar age and fractional age; however, the summaries including ages in this report were based on adjusted calendar age.

Delivered ages and lengths:

Fishery-Dependent Results: Age and length composition

All fishery-dependent age data have been provided to the life history workgroup; what follows is a summary of the calendar ages and lengths of aged Mutton Snapper. The following summaries were performed using all fish that were caught in Florida waters and landed in the state. Data are presented as a single time unit and presented by individual collection year.

Age data are summarized for a total of 11,550 individuals. A total of 5,095 samples were collected from the commercial sector (44.1% of samples). The remainder of the age samples were obtained from surveys of the recreational sector, including 122 samples from private recreational boat trips, 1,633 from charter trips, and 4,672 from headboats. In addition, 28 aged fish were from an unassigned source (primarily fishing tournaments; Table 1). Within the regions where Mutton Snapper are routinely encountered by fishers (SEFL, KEYS) otoliths were collected by at least one sector in each year from 2000 to 2020 (Tables 2-5).

Approximately 30.1% (3,474) of aged fish were female, 33.9% (3,922) were male, and 35.9% (4,154 fish) were unsexed. Substantial differences were observed in mean ages and age distribution by both sector and region (Table 1). Within the areas with the highest catches, (SEFL and KEYS) the mean ages were substantially higher and mean sizes were substantially longer for fish caught in the KEYS in the charter, commercial, and headboat fleets. However, the fish sampled from the private fleet were substantially younger and smaller than their counterparts in SEFL (Table 1). A total of 22 fish were aged to 30+ years, and an additional 222 were between 20 and 29 years old. Age distributions for charter, commercial, and headboat sectors had long tails with several older individuals represented in each sector. Samples from the private fleet were quite sparse and were generally represented by the youngest fish (Figure 1). The age distribution was similar among the three fleets of the recreational fishery (charter boats, headboats, and private fishers) with the highest proportion of fish in each at age 3 and the second highest at age 4. The age distribution of the commercial fleet was substantially wider with individuals up to age 10 common within the data (Figure 2). Regardless of fleet, age distributions in the Florida Keys were wider than in other regions, particularly SEFL (Figure 3). Fish intercepted in the commercial fishery since 2010 contained a particularly wide age distribution (Tables 2-5, Figure 4).

Age-length distributions were similar across sectors with fish representing a wide age range in the length range of 700-850 mm fork length. The youngest and smallest fish were collected from the private fleet with very few larger fish represented (Figure 5). Because of a recent regulation change a substantial number of fish collected from the fishery were below the current minimum legal size.

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Table 1. Total numbers of samples, mean (± SD) age, and mean (± SD) fork length (FL) from each fleet in each of the five regions of the state of Florida. Italicized values are state-wide totals for each fleet.

Region	**Charter**			**Commercial**		
	N	*Mean Age (SD)*	*Mean FL (SD)*	*N*	*Mean Age (SD)*	*Mean FL (SD)*
NEFL	33	8. 12 ± 6.40	590 ± 98	470	9.40 ± 6.24	600 ± 101
SEFL	957	3.54 ± 1.15	421 ± 60	1502	4.43 ± 1.63	466 ± 81
KEYS	634	6.57 ± 3.73	525 ± 110	1761	7.95 ± 4.66	576 ± 113
SWFL	6	5.33 ± 3.39	534 ± 127	1338	8.93 ± 5.32	615 ± 112
NWFL	3	11.33 ± 6.66	729 ± 48	24	7.95 ± 4.65	629 ± 103
Statewide	*1,633*	*4.83 ± 3.08*	*467 ± 100*	*5,095*	*7.31 ± 4.82*	*556 ± 120*

Region	**Headboat**			**Private**		
	N	*Mean Age (SD)*	*Mean FL (SD)*	*N*	*Mean Age (SD)*	*Mean FL (SD)*
NEFL	3	4.33 ± 0.58	506 ± 84	2	4 ±1.41	434 ± 35
SEFL	3473	3.58 ± 1.08	412 ± 58	83	4.29 ± 1.43	475 ±96
KEYS	1107	7.61 ± 3.91	546 ±109	34	3.91 ± 2.08	428 ± 112
SWFL	89	5.88 ± 2.55	554 ± 108	3	4 ± 1.73	521 ±120
NWFL	0	.	.	0	.	.
Statewide	*4,672*	*4.58 ±2.75*	*447 ± 95*	*122*	*4.19 ± 6.29*	*462 ± 102*

Table 2. **CHARTER BOAT FLEET:** Total numbers of samples, mean (± SD) age, and mean (± SD) fork length (FL) from each fleet, by year (2000-2020), in the two regions of the state with the highest Mutton Snapper encounter rate (SEFL & KEYS).

CHARTER BOAT										
Year	**Southeast Florida**					**Florida Keys**				
	N	*Mean age*	*Age STD*	*Mean FL*	*FL STD*	*N*	*Mean age*	*Age STD*	*Mean FL*	*FL STD*
2000	0	.	.	.	.	1	6.00	0.00	687.0	0.0
2001	17	3.53	0.80	426.2	54.7	0	.	.	.	.
2002	48	3.27	1.05	419.5	64.7	32	4.34	1.79	470.9	105.5
2003	189	3.32	0.92	424.2	49.6	5	8.20	3.83	618.2	83.9
2004	108	3.82	1.32	428.4	66.0	1	4.00	0.00	437.0	0.0
2005	249	3.35	1.28	407.8	56.1	0	.	.	.	.
2006	65	3.46	0.89	406.3	65.7	0	.	.	.	.
2007	0	.	.	.	.	0	.	.	.	.
2008	0	.	.	.	.	29	6.76	3.04	577.8	99.7
2009	5	4.80	0.84	504.0	84.9	37	7.16	4.30	518.2	119.1
2010	21	4.29	1.15	419.1	53.3	7	6.57	2.51	503.7	103.8
2011	78	4.22	0.80	427.5	52.2	41	8.39	4.01	591.6	111.1
2012	0	.	.	.		2	6.00	1.41	585.5	133.6
2013	23	2.65	0.57	416.9	40.0	8	8.38	6.35	560.8	129.3
2014	31	3.42	1.65	419.0	79.6	23	5.57	2.33	494.9	108.9
2015	57	3.26	0.79	412.6	54.3	25	4.40	2.68	442.5	91.1
2016	0	.	.	.	.	43	4.91	2.98	467.7	109.8
2017	27	4.19	1.00	472.6	88.9	98	6.44	4.27	533.2	110.4
2018	20	4.00	0.80	444.7	73.0	190	8.05	3.85	552.5	101.4
2019	15	4.27	1.10	450.9	52.8	66	4.50	1.30	475.4	76.4
2020	4	4.75	0.50	439.3	32.5	26	5.23	1.31	504.7	95.7

Table 3. **COMMERCIAL FLEET:** Total numbers of samples, mean (± SD) age, and mean (± SD) fork length (FL) from each fleet, by year (2000-2020), in the two regions of the state with the highest Mutton Snapper encounter rate (SEFL & KEYS).

COMMERCIAL										
Year	**Southeast Florida**					**Florida Keys**				
	N	*Mean age*	*Age STD*	*Mean FL*	*FL STD*	*N*	*Mean age*	*Age STD*	*Mean FL*	*FL STD*
2000	1	4.00	0.00	488.0	0.0	0	.	.	.	.
2001	28	3.36	0.87	418.7	64.8	0	.	.	.	.
2002	36	3.53	0.74	436.9	64.6	0	.	.	.	.
2003	2	4.50	0.71	400.0	7.1	4	4.25	0.50	412.5	47.2
2004	5	5.20	1.64	517.4	88.7	5	7.00	0.71	682.2	15.6
2005	0	.	.	.	.	10	5.80	2.25	551.2	123.8
2006	8	3.50	0.76	411.9	50.2	11	5.18	2.32	523.8	138.3
2007	3	5.67	2.89	509.7	96.5	71	10.93	5.60	643.5	98.6
2008	201	3.36	1.08	404.5	65.0	185	6.97	3.99	558.9	114.4
2009	134	4.08	0.91	427.1	65.5	89	7.25	4.45	543.2	126.4
2010	375	4.42	1.14	464.6	74.1	270	7.89	4.65	582.6	121.6
2011	349	4.86	1.02	495.8	73.2	231	7.73	4.19	573.8	113.7
2012	79	5.32	1.93	511.3	75.9	87	7.84	4.57	570.3	110.4
2013	46	4.37	1.61	459.5	62.0	32	8.59	5.27	573.6	110.7
2014	61	5.54	3.04	518.6	104.8	170	8.98	4.69	609.0	108.3
2015	17	3.82	1.24	446.7	82.5	49	8.88	5.37	582.5	119.3
2016	27	4.22	1.31	462.8	76.5	43	6.49	5.27	513.1	116.0
2017	25	6.12	3.97	531.6	102.3	139	7.90	4.83	572.8	98.9
2018	30	5.17	4.65	487.4	82.5	184	9.22	5.41	585.6	105.2
2019	68	4.31	0.97	487.7	62.2	96	7.02	3.30	569.8	94.1
2020	7	6.00	1.16	555.4	45.9	85	6.37	3.11	550.3	95.1

Table 4. **HEADBOAT FLEET:** Total numbers of samples, mean (± SD) age, and mean (± SD) fork length (FL) from each fleet each year (2000-2020) in the two regions of the state with the highest Mutton Snapper encounter rate (SEFL & KEYS).

HEADBOAT										
Year	**Southeast Florida**					**Florida Keys**				
	N	*Mean age*	*Age STD*	*Mean FL*	*FL STD*	*N*	*Mean age*	*Age STD*	*Mean FL*	*FL STD*
2000	0	.	.	.	.	0	.	.	.	.
2001	9	3.11	0.78	409.3	43.3	0	.	.	.	.
2002	0	.	.	.	.	0	.	.	.	.
2003	0	.	.	.	.	0	.	.	.	.
2004	120	3.65	1.29	439.4	67.0	2	11.50	3.54	592.5	17.7
2005	197	3.35	1.10	417.7	71.7	10	9.50	7.40	588.8	108.6
2006	163	3.34	0.88	407.9	50.8	0	.	.	.	.
2007	222	3.33	1.30	411.8	62.5	7	8.00	7.92	540.4	146.7
2008	466	3.35	0.99	405.0	60.6	178	8.11	4.10	580.4	107.8
2009	541	3.68	0.89	405.2	54.3	321	7.76	3.90	552.8	107.6
2010	561	3.86	0.88	411.5	46.0	299	7.55	3.52	530.6	100.9
2011	237	4.12	1.01	431.9	57.4	185	8.07	4.12	561.8	110.8
2012	54	4.89	1.65	467.6	76.5	0	.	.	.	.
2013	68	3.43	2.15	418.4	74.4	0	.	.	.	.
2014	210	2.98	0.67	400.0	47.0	4	3.25	0.50	357.5	2.9
2015	188	3.30	0.86	397.9	49.6	2	3.00	1.41	412.0	60.8
2016	199	3.40	1.01	407.6	58.9	37	4.97	2.03	472.5	96.1
2017	98	3.56	0.87	413.8	61.6	10	5.50	2.12	486.4	106.0
2018	81	3.70	0.78	432.7	48.6	19	5.58	1.22	492.0	66.5
2019	52	4.35	1.37	454.6	70.7	30	6.47	3.61	505.2	101.0
2020	7	4.71	1.25	440.4	60.2	3	4.67	0.58	413.0	13.1

Table 5. **PRIVATE BOAT FLEET:** Total numbers of samples, mean (± SD) age, and mean (± SD) fork length (FL) from each fleet, by year (2000-2020), in the two regions of the state with the highest Mutton Snapper encounter rate (SEFL & KEYS).

PRIVATE BOAT										
Year	**Southeast Florida**					**Florida Keys**				
	N	*Mean age*	*Age STD*	*Mean FL*	*FL STD*	*N*	*Mean age*	*Age STD*	*Mean FL*	*FL STD*
2000	0	.	.	.	.	0	.	.	.	.
2001	6	3.83	0.75	438.3	49.8	1	3.00	0.00	444.0	0.0
2002	2	3.00	1.41	442.5	53.0	2	2.50	0.71	349.5	6.4
2003	7	3.86	0.90	448.7	68.0	0	.	.	.	.
2004	4	3.00	1.63	416.3	49.2	0	.	.	.	.
2005	3	3.00	1.00	348.7	28.7	0	.	.	.	.
2006	0	.	.	.	.	0	.	.	.	.
2007	0	.	.	.	.	0	.	.	.	.
2008	2	5.50	0.71	657.5	53.0	3	7.33	1.53	571.7	89.9
2009	8	5.13	1.13	562.6	76.3	0				
2010	12	5.75	1.55	575.2	96.8	1	7.00	0.00	675.0	0.0
2011	6	4.83	0.98	454.2	72.5	0	.	.	.	.
2012	0	.	.	.	.	0	.	.	.	.
2013	0	.	.	.	.	0	.	.	.	.
2014	0	.	.	.	.	4	2.50	0.58	322.3	29.1
2015	0	.	.	.	.	0	.	.	.	.
2016	0	.	.	.	.	0	.	.	.	.
2017	6	3.17	0.75	415.0	48.2	11	3.27	1.01	383.4	63.8
2018	12	4.25	1.42	481.5	74.0	5	4.00	2.35	430.8	117.6
2019	12	3.83	1.27	402.5	48.1	6	5.17	2.23	506.8	103.2
2020	3	4.33	0.58	502.7	96.6	1	1.00	0.00	331.0	0.0

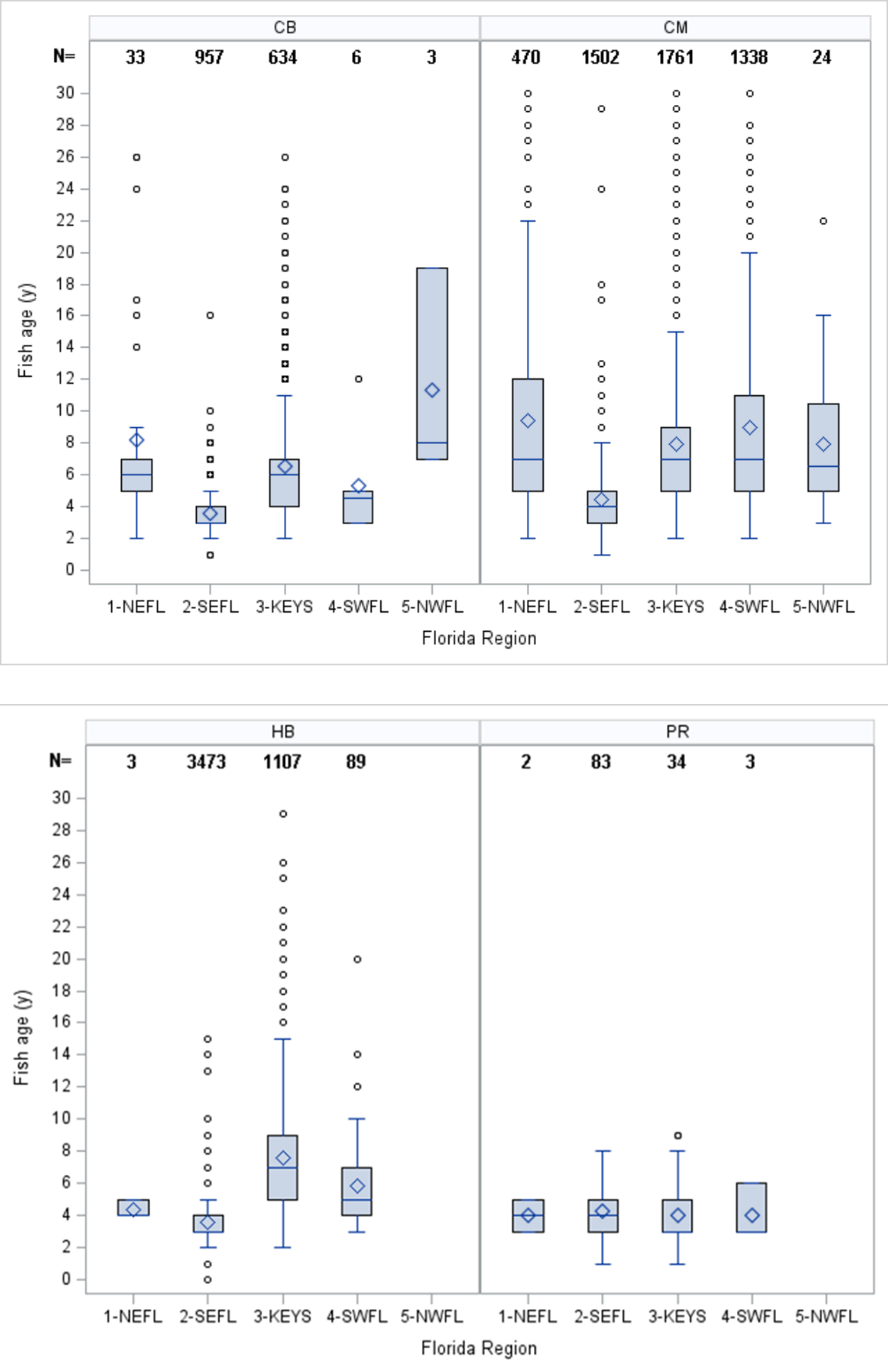

Figure 1. Age distribution of fish collected from each of four fishing fleets in the 5 regions of Florida. CB: Charter boat, CM: Commercial, HB: Headboat, PR: Private boat.

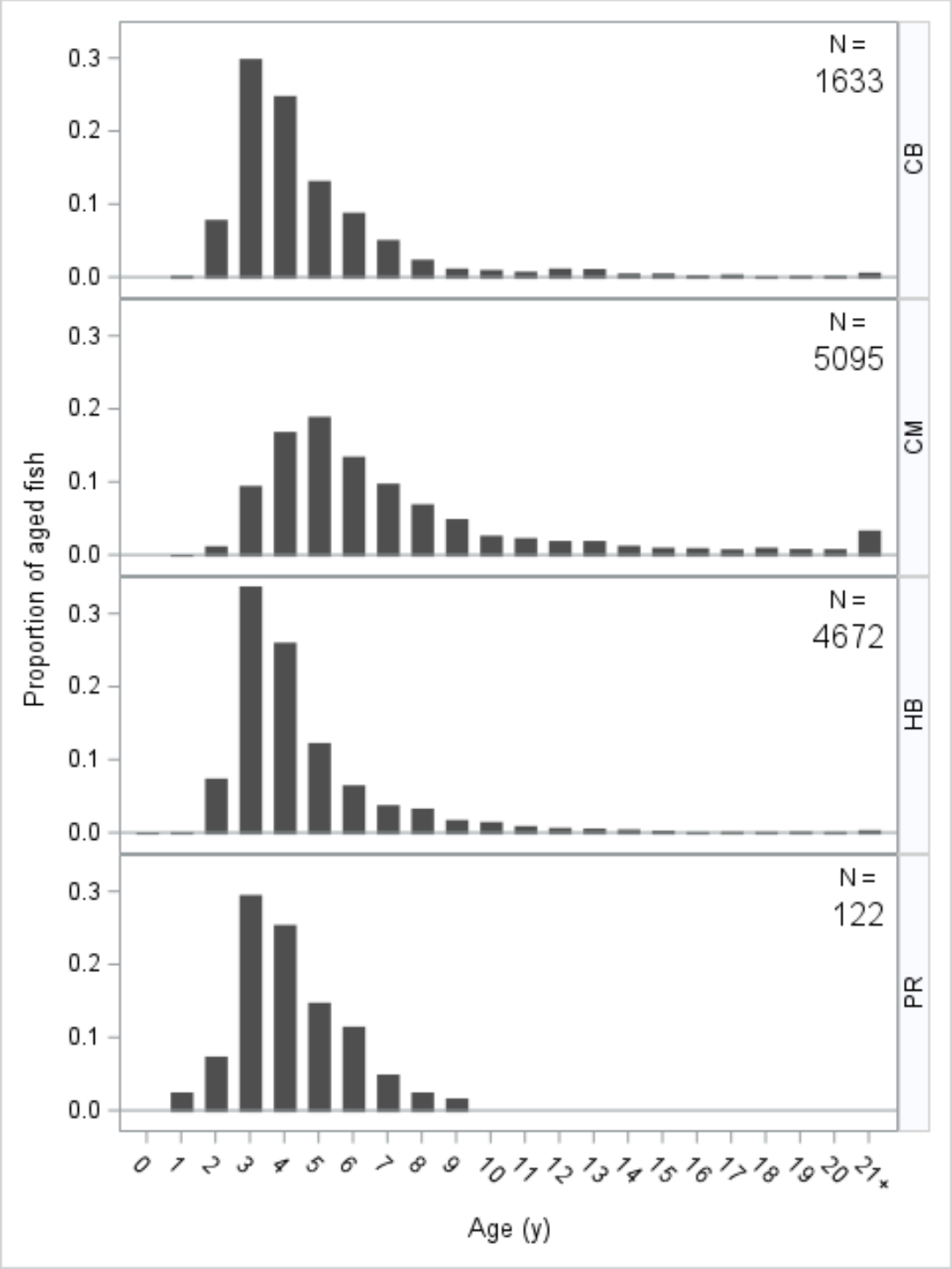

Figure 2. Proportion of aged fish in each calendar age by fishing fleet. All years of data collections and all regions of the state are combined. CB: Charter boat, CM: Commercial, HB: Headboat, PR: Private boat.

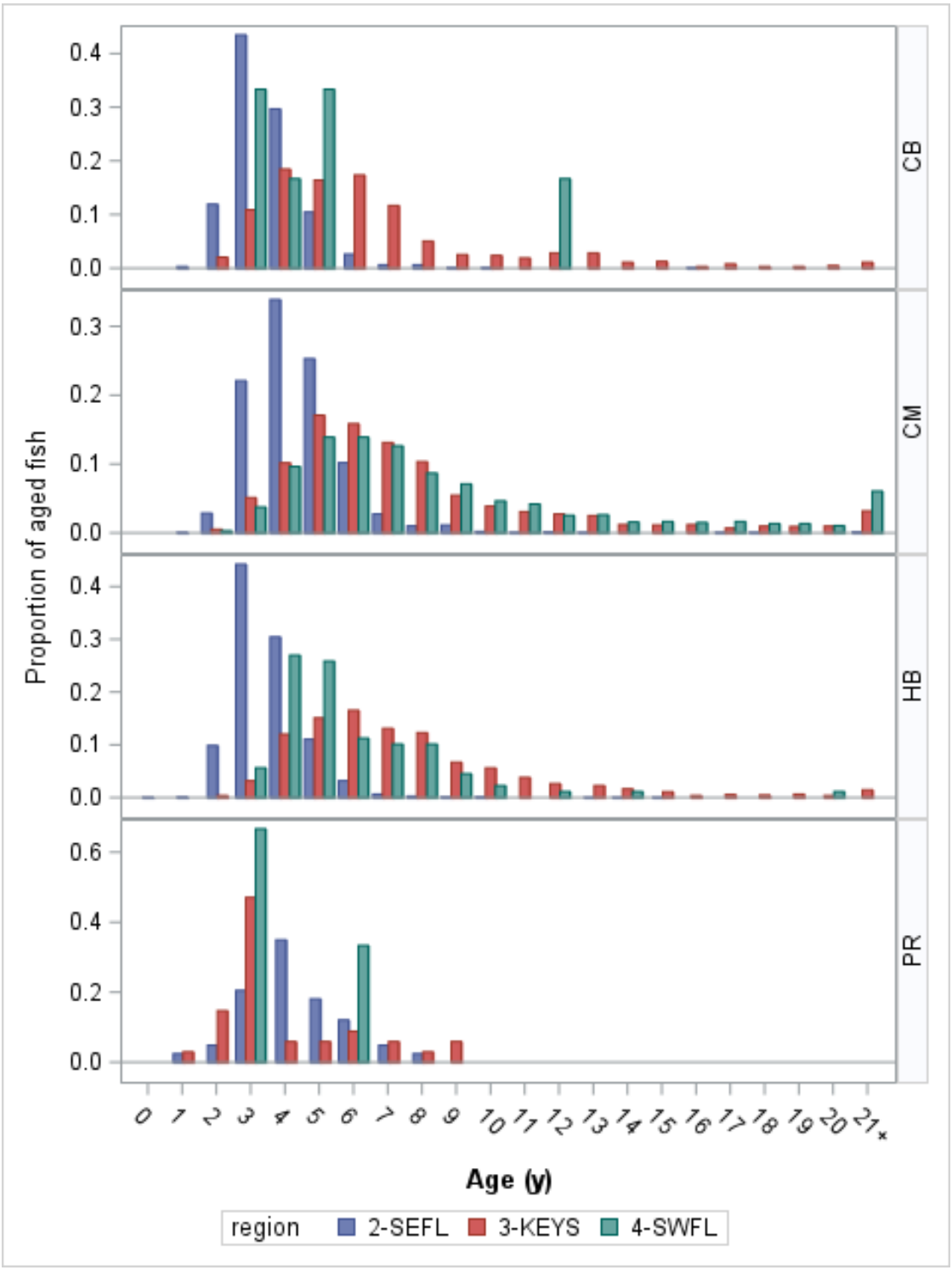

Figure 3. Proportion of aged fish in each calendar age by fishing fleet and region. All years of data collections are combined. **These data only include the three regions of Florida where Mutton Snapper are most commonly encountered**. CB: Charter boat, CM: Commercial, HB: Headboat, PR: Private boat.

Figure 4. Proportion of aged fish in each calendar age by fishing fleet and year. All regions of Florida are combined. CB: Charter boat, CM: Commercial, HB: Headboat, PR: Private boat.

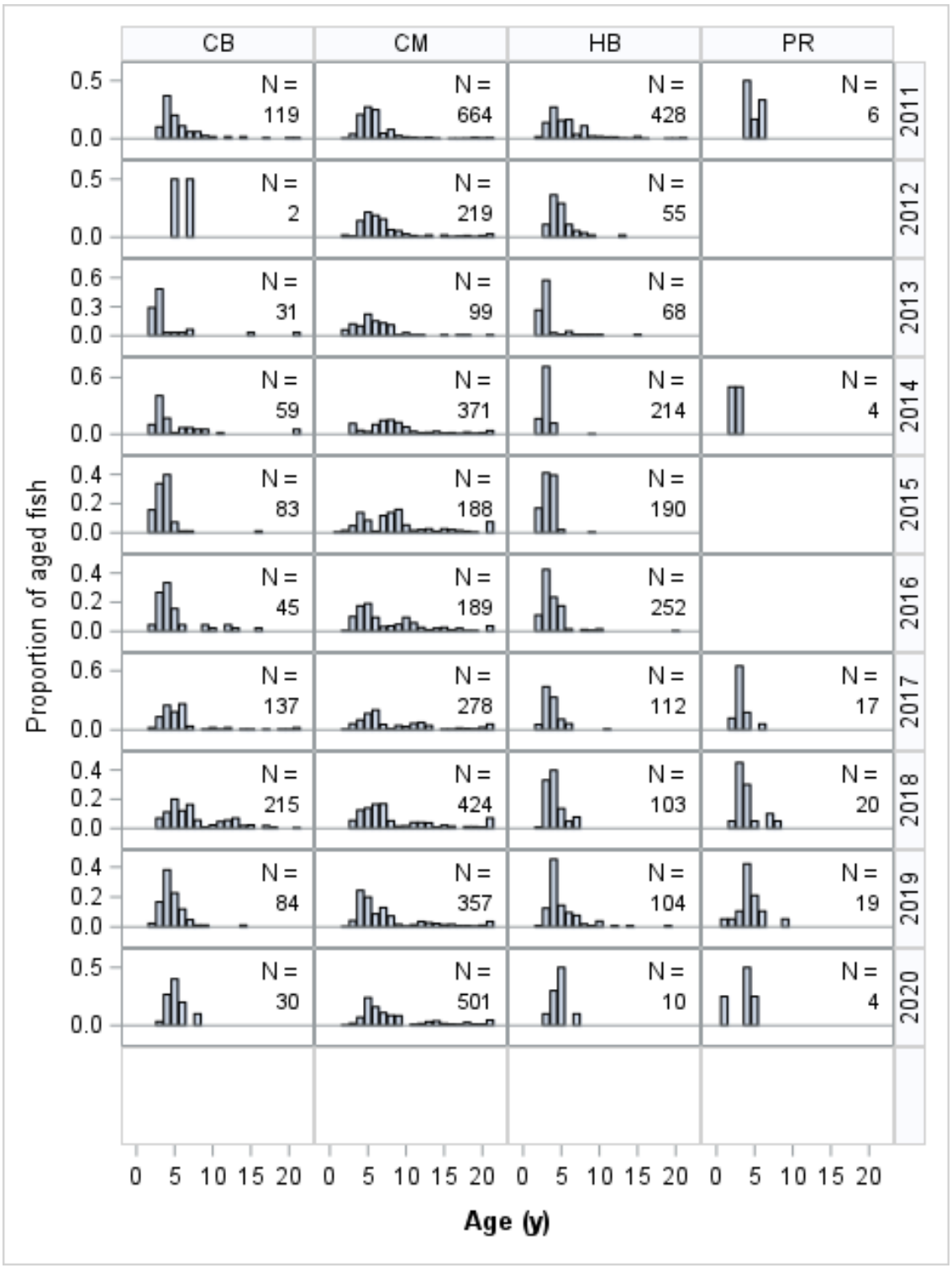

Figure 4 (cont.). Proportion of aged fish in each calendar age by fishing fleet and year. All regions of Florida are combined. CB: Charter boat, CM: Commercial, HB: Headboat, PR: Private boat.

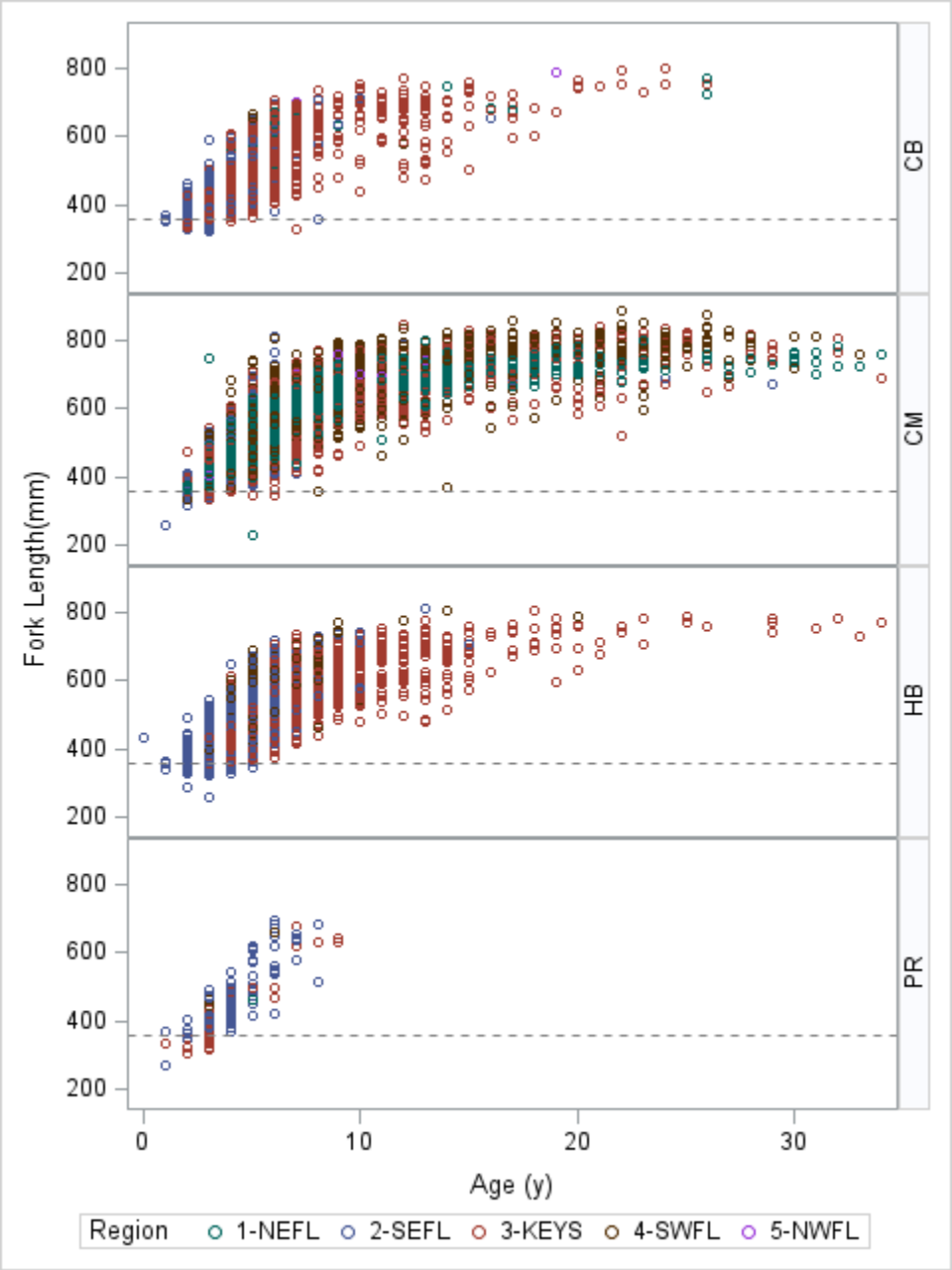

Figure 5. Length as a function of age by fishing fleet. All regions of the state are denoted by the color of the mark. Dotted line represents fork length (FL) of fish at the current legal minimum size (18” TL).