Length and age composition of Florida Hogfish, *Lachnolaimus maximus*, collected in association with fishery-dependent projects

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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) monitors commercial and recreational fishing in marine environments along the Florida coast in association with several fishery-dependent research and monitoring projects. FDM administers three federal surveys: the Marine Recreational Information Program (MRIP) and The Southeast Region Headboat Survey (SRHS) for the recreational sector, and the Trip Interview Program (TIP) for the commercial sector. Additionally, FDM conducts several unique surveys of recreational anglers that allow for the collection of supplemental biological data. Each fishery-dependent research or monitoring project that contributed age and length data to the Life History Group is detailed below. During these surveys, priority was given to collecting the left otolith when removing both otoliths was not feasible, to ensure the prompt return of fish to anglers.

Commercial Fishery Data

Trip Interview Program (TIP)

The commercial fishery is sampled through the NOAA Trip Interview Program (TIP), in which Florida actively participates. The TIP program primarily focuses on collecting random size-frequency data and biological samples from commercially harvested marine species. Samplers gather information from fish offloaded from commercial fishing vessels, including fork length and natural total length (measured in millimeters). Weight measurements are recorded as whole weight or gutted weight (measured in kilograms), depending on the fish's condition upon landing. To preserve fillet integrity, a single otolith is typically extracted from beneath the operculum. Length and weight data are submitted as part of a unified federal dataset.

Recreational Fishery Data

For-Hire At-Sea Observer Sampling

Gulf Coast of Florida

From 2005-2007, at-sea observer survey coverage on headboats operating from Alabama and the Gulf coast of Florida, from the panhandle through the Keys, was funded by the Gulf Fisheries Information Network (Gulf FIN). There was a gap in funding from January 2008 through May 2009. In June 2009, the state of Florida secured alternative funds to continue at-sea observer coverage in the northwest panhandle and central peninsula, including both the charter and headboat fleet. In 2014, coverage on headboats was limited to a small number of vessels participating in a pilot study for IFQ shares. Thus, data from this year are not considered representative of the fishery as a whole. Since 2015, there has been consistent coverage of both charter and headboats from the panhandle through the Florida Keys.

South Atlantic coast of Florida

On the South Atlantic coast, at-sea headboat sampling has been conducted continuously since 2005 funded by the Atlantic Coast Cooperative Statistic Program (ACCSP), with this report including data collected between 2005 and 2024. At-sea sampling on Atlantic coast charter boats was funded with a 3-year MARFIN grant from 2013-2015, and there was a gap in funding from January 2016-May 2020. In July 2020, the state of Florida secured funds through the State Reef Fish Survey to expand coverage to east Florida, but trips were not observed through this funding until April 2021 due to the COVID-19 pandemic. There has been consistent coverage of charter boats since sampling coverage was re-initiated in April 2021.

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. Since 2015, there has been consistent coverage of both charter and headboats in the Florida Keys.

Collection Method

For the survey, both headboats and charter boats were randomly selected on a weekly basis throughout the year. Biological data was collected from harvested Hogfish dockside after observed trips, including midline length (mm), whole weight (kg), and whenever possible, a left otolith was extracted from sampled fish. 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

The State Reef Fish Survey (SRFS) has run continuously on the Florida Gulf coast since May 2015 when it was previously named Gulf Reef Fish Survey. Expanding state-wide in 2020, it was renamed to SRFS. 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 Hogfish, on Florida's coast 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-in survey and a dockside intercept survey. The mail-in survey is sent to randomly selected anglers with the State Reef Fish Angler designation to collect data on angler effort. The dockside intercept survey stations biologists at sampling sites to interview anglers 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. Data collected during dockside assignments include information regarding fishing depths, distances from shore while fishing for offshore species, number of harvested fish, and self-reported estimates of fish released during the fishing day. A subset of harvested fish are measured (fork length in mm) and weighed (in kilograms) during the survey.

Opportunistic Biological Sampling

Between 2000 and 2018 opportunistic biological sampling was conducted at angler intercept sites along the Gulf and Atlantic 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 by 2019 along the entire 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). RepBio expanded to the Atlantic coast in November 2020. From January 1st, 2024, to August 1st, 2024, RepBio experienced a funding gap. No biological samples were collected during this period.

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 was processed. The otolith core was marked with a pencil, and the otolith was embedded in a 5:1.1 weighted ratio of araldite to hardener using the methods described in VanderKooy et al. (2020). The embedded resin blocks were then mounted on card stock using hot glue. Processing of the otoliths was completed on a four-bladed Buehler Isomet low-speed wafering saw, as described in VanderKooy et al. (2020). After processing, three transverse sections of approximately 400 µm thickness encompassing the core were mounted on a glass slide and covered with a chemical mounting medium.

Sectioned otoliths were examined on a stereo microscope using transmitted light. Ageing was conducted from the core to the edge along an axis near the sulcal groove. Each otolith was examined with at least two blind reads. When age estimates did not agree between reads, a third read was conducted to resolve the discrepancy.

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). McBride and Richardson (2007) indirectly validated annulus formation of Hogfish using marginal increment analysis and determined peak opaque zone formation occurs in May on both coasts of Florida. Hogfish spawning typically occurs during the winter and spring months, with peak activity occurring December through April (McBride and Johnson, 2007; Collins and McBride 2011). 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 (McBride and Richardson 2007).

The FWRI Marine Fisheries Age and Growth Laboratory aged 1,074 otoliths for the Fishery Dependent Monitoring section in support of SEDAR94. Four individual readers contributed to ageing otoliths that were delivered following SEDAR94. Prior to ageing these samples, all staff reviewed previously aged samples 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 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 0.47%, which is considered highly precise (Campana 2001); moreover, there was a 94% age agreement between all first and second reads, and a 99% agreement +/- 1 year. All age data provided for SEDAR94 included increment count, calendar age and fractional age; however, the summaries including ages in this report were based on adjusted calendar age.

Results

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 Hogfish. Age data are available for a total of 847 individuals. The majority of age samples were obtained from the West Florida Shelf (WFS) stock, accounting for 657 samples (78%). Within the WFS, 36% of the aged otoliths were from the Headboat sector, followed by the Charter sector (27%) and the Private sector (18%) (Table 1). The Keys and East Florida (KEYS/EFL) stock accounts for 190 (22%) of the total aged fish, with

more than half of these samples coming from the Commercial sector (55%). The Private sector contributed the second-highest number of aged fish in KEYS/EFL, with 52 (27%) (Table 1).

Across both stocks, the Private sector generally sampled younger and smaller Hogfish, particularly in KEYS/EFL where the lowest mean age was 4.19± 1.62 years. The highest mean age was observed in the KEYS/EFL Headboat fleet at 8.333 ± 2.87 years. The oldest Hogfish sampled was also from the KEYS/EFL Headboat fleet, aged at 16 years. The next oldest were two 15-year-old individuals, both collected from the Commercial fleet in the WFS. In total, 15 Hogfish were aged at over 10 years old between the two stocks (Figure 1).

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Table 1. Number of fish aged, mean (± SD) age and length by stock and fishing fleet (2002-2024).

	WFS			KEYS/EFL		
Fishing Fleet	# Fish	Mean Age (y)	Mean FL (mm)	# Fish	Mean Age (y)	Mean FL (mm)
Charter	178	5.45 ± 1.51	380.90 ± 40.41	18	4.5 ± 1.86	349 ± 57.47
Commercial	98	5.94 ± 2.11	405 ± 84.17	104	4.79 ± 1.94	349.70 ± 49.34
Headboat	234	5.14 ± 1.48	384.80 ± 30.24	12	8.33 ± 2.87	409.5 ± 63.66
Private	118	4.63 ± 1.38	382.56 ± 43.57	52	4.19 ± 1.62	395.08 ± 57.28
Tournament	29	5.90 ± 2.60	425.83 ± 113.89	4	4.5 ± 1	440.25 ± 43.76

Table 2. Number of fish aged, mean (± SD) age and length by stock, fishing fleet, and year (2002-2024).

WFS						KEYS/EFL					
	# Fish	Mean Age (y)	Mean FL (mm)	SD Age	SD FL		# Fish	Mean Age (y)	SD AGE	Mean FL (mm)	SD FL
Charter											
2002	1	3	280	.	.	2003	2	3.5	365	0.707	118.794
2013	3	3.333	299.667	2.309	53.529	2009	9	5.222	331.444	2.333	28.862
2014	11	5	377.091	1.949	71.115	2010	1	4	294	.	.
2015	23	4.826	373.739	1.527	46.348	2016	3	3.333	351.333	0.577	24.583
2017	2	7	417.5	2.828	28.991	2017	2	4	368.5	1.414	94.045
2018	4	6	385	1.414	27.398	2022	1	5	484	.	.
2019	13	5.692	379.462	1.601	33.548						
2020	47	5.66	370.809	1.418	27.128						
2021	17	5.941	378.765	1.6	39.689						
2022	30	5.633	399.267	1.129	27.248						
2023	7	6.143	403.429	1.773	32.736						
2024	20	5	403.95	1.026	31.46						
Commercial											
2010	1	4	408	.	.	2010	14	4.214	354.429	2.119	59.429
2012	9	5.556	359.667	0.527	36.031	2011	34	4.324	351.912	1.87	61.861
2013	24	6.333	393.333	1.049	47.605	2012	14	4.214	332.643	2.045	32.064
2014	12	9.333	535.75	3.229	153.635	2013	6	6.167	356.833	1.169	41.073
2015	1	11	682	.	.	2014	6	6.667	359.833	1.033	29.956
2017	7	2.857	415.286	0.69	42.668	2015	15	6.333	344.067	1.291	26.166
2020	34	5.176	372.176	0.904	17.112	2016	14	3.786	350.5	1.122	49.774
2021	10	5.7	393.3	0.483	15.312	2022	1	8	417	.	.

Table 2. Continued.

	WFS						KEYS/EFL				
	# Fish	Mean Age (y)	SD AGE	Mean FL (mm)	SD FL		# Fish	Mean Age (y)	SD AGE	Mean FL (mm)	SD FL
Headboat											
2013	1	2	376	.	.	2005	3	9	471.333	6.083	66.493
2015	3	6.667	379	2.082	35.679	2006	1	10	365	.	.
2016	4	5	379.25	0	48.121	2009	2	7.5	427.5	0.707	67.175
2018	13	5.308	384.077	1.251	31.213	2010	1	8	436	.	.
2019	36	5.722	387.389	1.301	30.073	2013	1	6	412	.	.
2020	3	6	395.333	0	24.007	2014	2	8	335	1.414	25.456
2021	41	4.634	384.561	1.356	30.749	2015	1	10	342	.	.
2022	70	4.771	384	1.446	31.707	2023	1	8	420	.	.
2023	17	4.353	390.118	0.996	25.724						
2024	46	5.87	382.804	1.529	29.723						
Private											
2003	11	3.727	356.273	0.905	35.168	2002	1	2	349	.	.
2008	1	3	427	.	.	2004	3	2.667	372	1.155	39.509
2009	3	4	380	0	79.681	2005	2	3.5	390	0.707	48.083
2010	1	4	305	.	.	2010	2	4.5	376.5	2.121	30.406
2012	10	5.1	386.6	1.101	56.951	2011	2	4	330	0	24.042
2014	1	6	439	.	.	2015	1	3	313	.	.
2016	9	4.444	399.444	0.527	46.452	2017	8	3.125	366.25	1.458	91.54
2019	1	3	379	.	.	2018	5	3	382	0.707	37.557
2020	14	5	372.357	1.468	27.952	2020	2	2.5	326	0.707	5.657
2021	16	4.625	380.375	1.962	36.096	2021	5	5.8	421.4	1.095	31.005
2022	12	4.833	408.667	1.267	63.321	2022	11	4.364	423.182	1.206	37.064
2023	16	4.313	368.688	1.401	25.85	2023	9	5.889	430.889	1.167	44.473
2024	23	5	390	1.348	37.649	2024	1	6	441	.	.
Tournament											
2010	1	9	715	.	.	2019	4	4.5	440.25	1	43.76
2012	10	5.9	386.4	2.726	102.501						
2013	4	6.75	467.75	4.573	200.151						
2014	2	5.5	487	3.536	87.681						
2019	12	5.417	410.417	1.676	46.903						

Table 3. Number of fish aged, mean age and length by stock, fleet, and gear type.

WFS						
FISHING FLEET	GEAR TYPE	# FISH	MEAN AGE (y)	SD AGE	MEAN FL (mm)	SD FL
CHARTER	HOOK/LINE	178	5.45	1.52	381.90	40.41
COMMERCIAL	BANDIT RIG	2	5.50	0.71	383.50	12.02
	CAST NETS	6	7.33	2.25	480.17	185.68
	DIVING OTHER	22	5.27	0.70	380.36	19.90
	SPEARS	68	6.04	2.37	406.97	82.68
HEADBOAT	HOOK/LINE	234	5.14	1.48	384.80	30.24
PRIVATE	HOOK/LINE	74	4.60	1.24	383.07	45.51
	MULTI GEAR	6	5.00	0.89	396.33	26.29
	SPEARS	38	4.63	1.68	379.40	42.21
TOURNAMENT	SPEARS	29	5.90	2.60	425.83	113.89
KEYS/EFL						
FISHING FLEET	GEAR TYPE	# FISH	MEAN AGE (y)	SD AGE	MEAN FL (mm)	SD FL
CHARTER	HOOK/LINE	13	4.85	2.04	330.39	43.00
	SPEARS	5	3.60	0.89	397.40	66.59
COMMERCIAL	DIVING OTHER	9	5.33	2.29	332.22	40.20
	ELECTRIC H/L	1	7.00	.	355.00	.
	HOOK/LINE	11	5.09	2.12	422.73	78.70
	POTS/TRAPS	8	4.25	2.05	333.88	17.18
	SPEARS	53	5.06	1.98	343.81	38.74
	TRAP	12	4.17	1.64	347.00	46.30
	UNKNOWN	10	3.50	0.71	331.70	19.98
HEADBOAT	HOOK/LINE	12	8.33	2.87	409.50	63.66
PRIVATE	HOOK/LINE	8	3.00	2.07	341.75	35.69
	MULTI GEAR	4	5.25	0.96	434.25	62.31
	SPEARS	40	4.33	1.47	401.83	54.52
TOURNAMENT	SPEARS	4	4.50	1.00	440.25	43.76

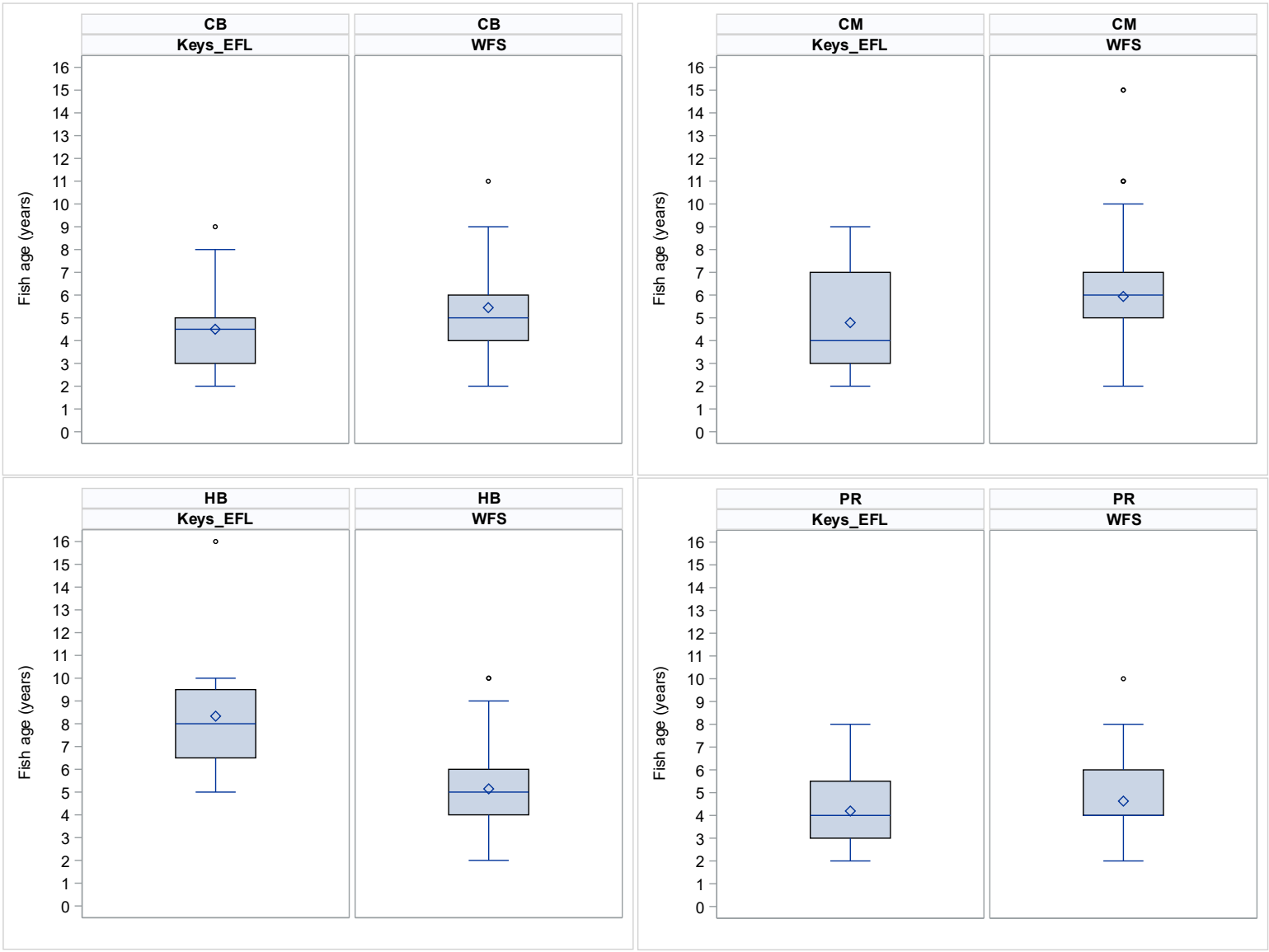

Figure 1. Age distribution by stock and fishing fleet. CB= Charter, CM= Commercial, HB=Headboat, PR= Private, TRN= Tournament.

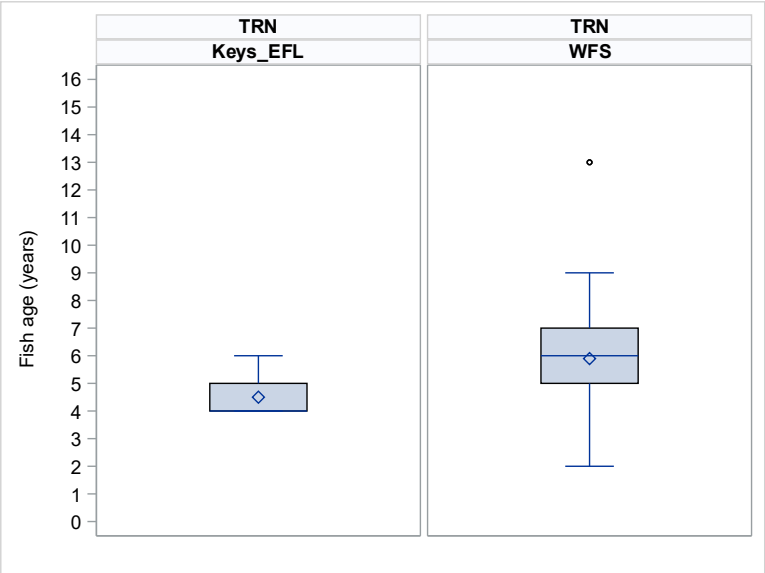

Figure 1 (cont.). Age distribution by stock and fishing fleet. CB= Charter, CM= Commercial, HB= Headboat, PR= Private, TRN= Tournament.

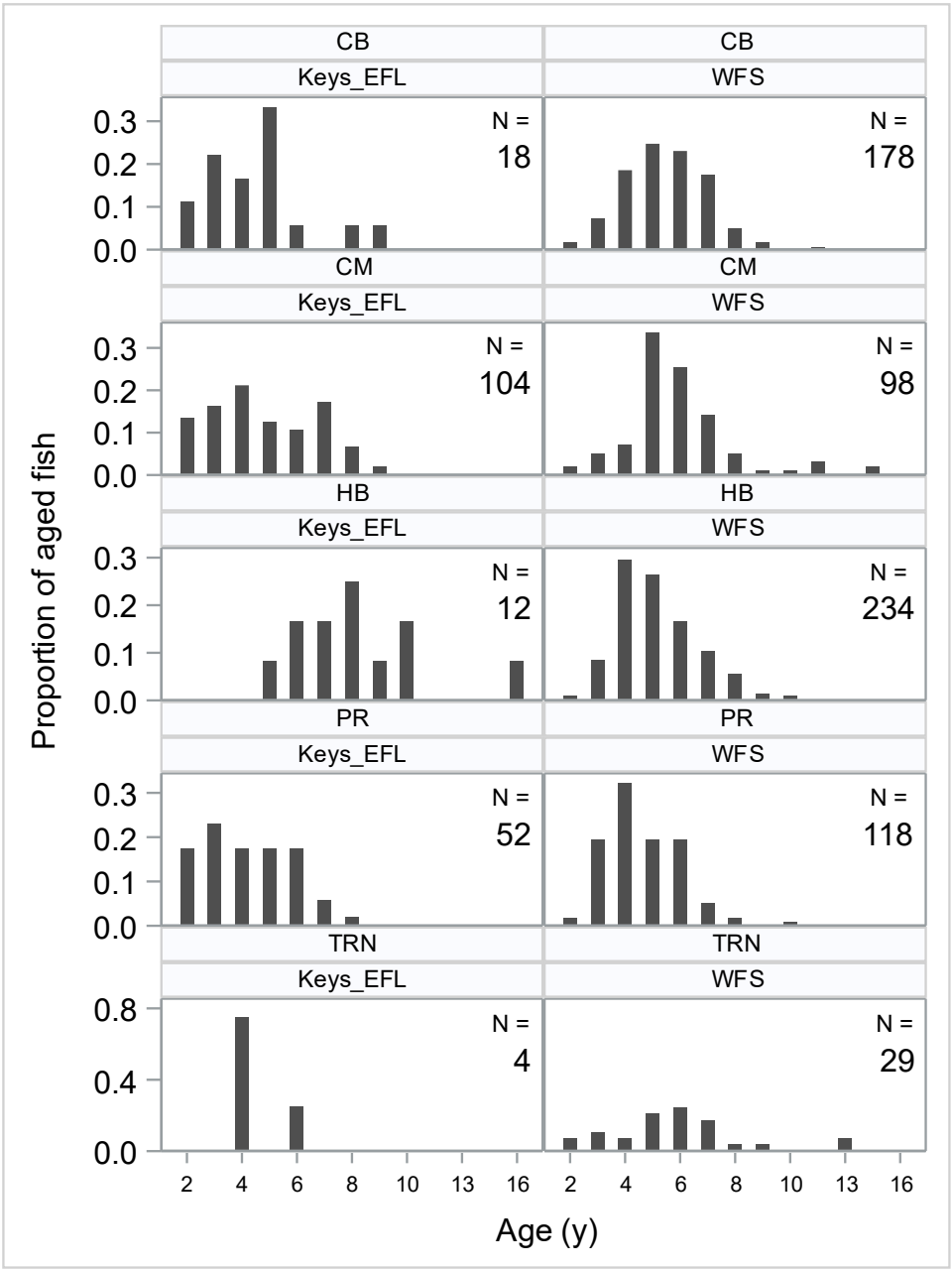

Figure 2. Age distribution of fish across entire time series in each fishery. CB= Charter, CM= Commercial, HB= Headboat, PR= Private, TRN= Tournament.

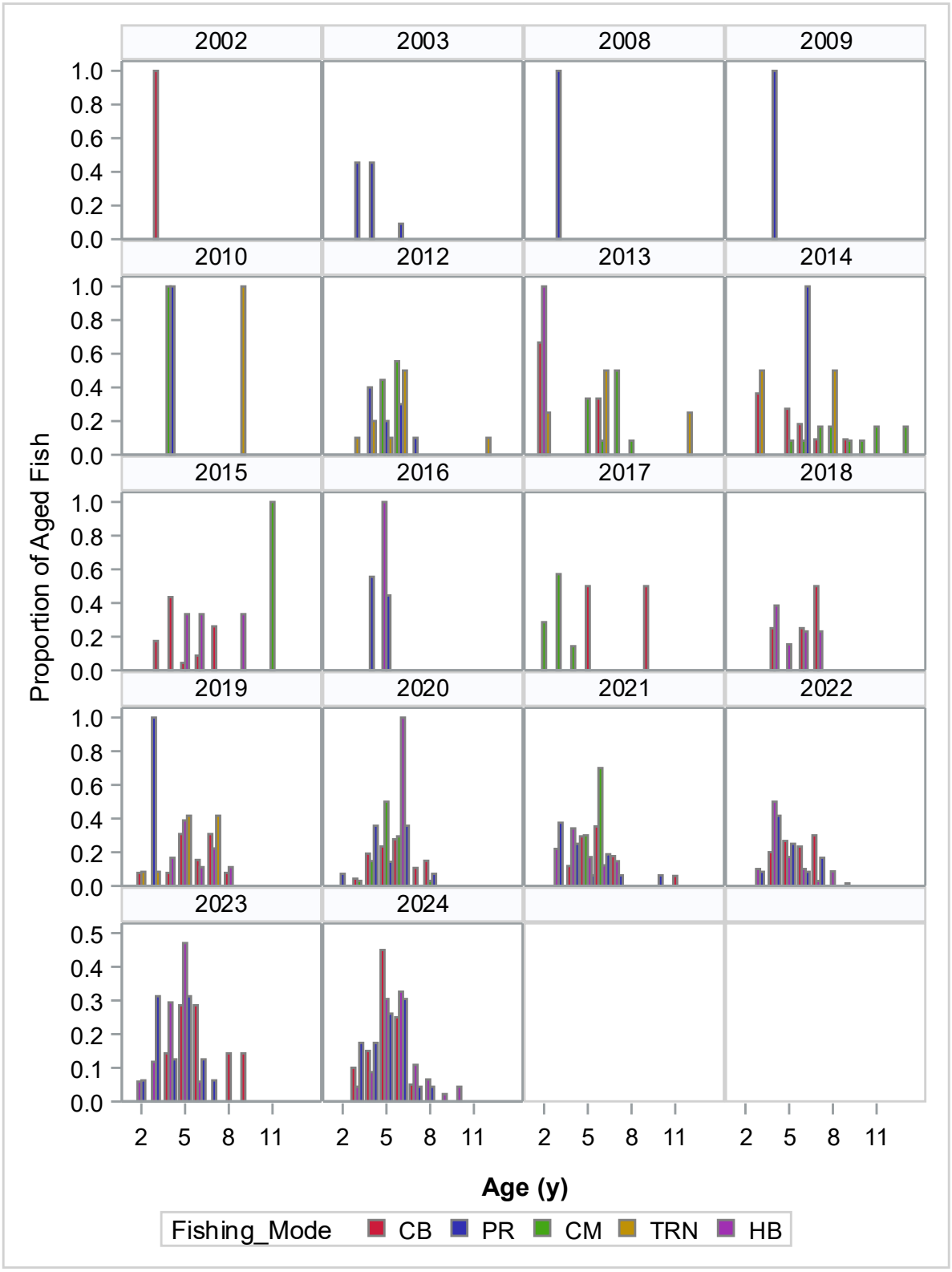

Figure 3. Proportion of total fish aged, by year and fleet, from the **WFS** stock.

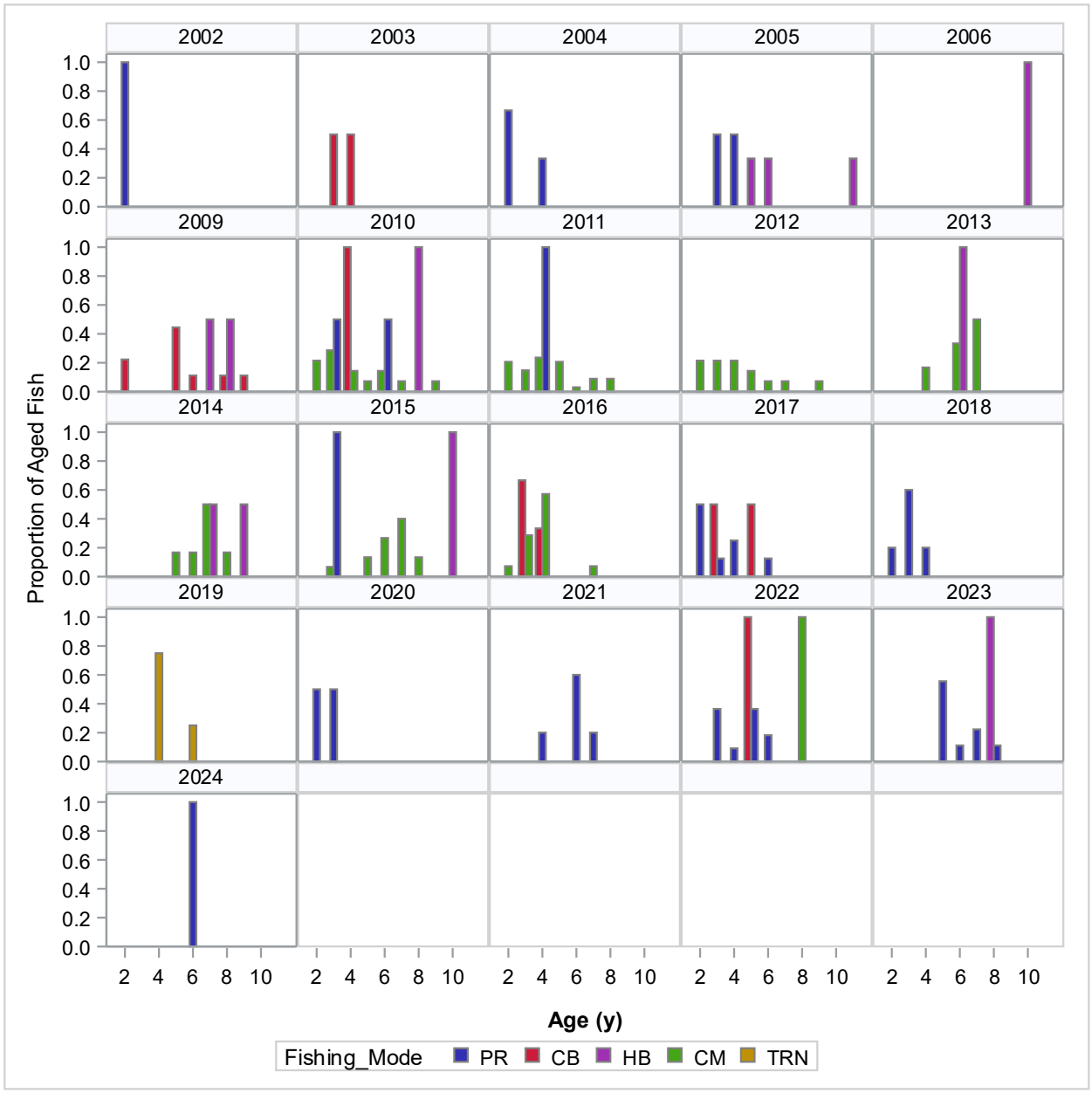

Figure 4. Proportion of total fish aged, by year and fleet, from the **KEYS/EFL** stock.