Greater amberjack (*Seriola dumerili*) otolith ageing summary for Panama City laboratory (2009-2012)

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INTRODUCTION

Several regional studies have examined the age and growth of greater amberjack (*Seriola dumerili*) off the Southeastern U.S. Burch (1979) used scales to age greater amberjack from the Florida Keys to a maximum of 10 years, while Manooch and Potts (1997a) used sagittal otoliths (hereafter otoliths) to age greater amberjack from head boat catches off Alabama and NW Florida obtaining a maximum age of 15 years. Thompson et al. (1999) also reported a maximum age of 15 years using otoliths to age amberjack caught off Louisiana. Greater amberjack collected off the U.S. South Atlantic were aged by Manooch and Potts (1997b) from the commercial and headboat fishery and Harris et al. (2007) from the recreational, commercial and fishery-independent surveys with reported maximum ages of 17 and 13 years respectively. More recently, Murie and Parkyn (2008) aged greater amberjack caught throughout the Gulf of Mexico from the commercial and recreational fisheries, as well as fishery independent surveys and obtained a maximum age of 15 years. The goal of this report is to summarize the size and age structure of greater amberjack aged by personnel from the Panama City laboratory for the SEDAR 33 benchmark assessment.

METHODS

Greater amberjack were sampled from Gulf of Mexico landings from Florida, Alabama, Louisiana and Texas. Samples were collected from the recreational and commercial fisheries and from fishery-independent surveys. Fish were measured to the nearest mm fork length (FL) and weighed to the nearest g, and sex was determined macroscopically if the fish was landed whole. One or both sagittal otoliths were removed, cleaned with distilled water, dried, weighed to the nearest 0.0001 g and imaged using image analysis software if whole. All otolith collections were processed and aged if the otolith was readable.

Otolith processing and ageing

Prior to processing and ageing greater amberjack otoliths, a workshop was conducted by Dr. Debra Murie (University of Florida) at the Panama City laboratory on August 10-11, 2010 to train the Panama City staff and other gulf state personnel in processing and ageing of greater amberjack otoliths. Since greater amberjack otoliths were often broken during removal, the most intact sagittal otolith of the pair was selected for sectioning. Otoliths were embedded in plastic molds with Epofix resin® and sectioned through the core using a low-speed isomet saw equipped with 3 blades and 0.5 mm spacers. Two sections per otolith (0.5 mm thick) were mounted using Cytoseal 60® on the long axis of a microscope slide in a dorsal-ventral direction to aid in tilting the section for ageing (Murie and Parkyn 2013). Otolith thin sections were viewed using a compound microscope at 40x magnification with transmitted light. Ages were assigned by counting opaque zones including any partially completed opaque zones on the otolith margin and the degree of marginal zone completion. Ageing protocols were documented in an illustrated otolith ageing manual (Murie and Parkyn 2013). Each otolith section was assigned one of the following readability codes: good, readable (i.e., fair), difficult, unreadable or poor prep (unreadable due to preparation). Marginal increment analysis indicated that annuli in greater amberjack otoliths are laid down primarily in the Spring to Summer months (Manooch and Potts 1997a,b; Murie and Parkyn 2008). Therefore, age was advanced by one year if a large translucent zone was visible on the margin and capture date was 1 January to 30 June; after 30 June age was equal to opaque zone count. By this traditional method, an annual age cohort is based on a calendar year rather than time since spawning

(Jearld, 1983; Vanderkooy and Guindon-Tisdel, 2003). Biological (fractional) ages were also estimated for use in fitting growth curves. Biological age accounts for the difference in time between peak spawning (defined as 1 April for greater amberjack) and capture date (difference in days divided by 365). This fraction is added to annual age if capture date is after 1 April and subtracted if capture date is before 1 April (Vanderkooy and Guindon-Tisdel, 2003).

<u>Ageing precision</u>

To test the repeatability of ageing (i.e., precision), a length stratified reference set of 100 otolith sections was assembled by personnel from the University of Florida. Dr. Debra Murie's ages served as the reference ages, since she was most experienced and had worked with other amberjack ageing experts from the U.S. South Atlantic. Average percent error (APE; Beamish and Fournier, 1981) was used to estimate precision between the reference ages and reader ages. Two primary readers read all greater amberjack archived at the Panama City laboratory. Panama City reader 1 and reader 2 APEs compared to the reference age set were 2.6% and 3.1% respectively. A comparison of the consensus age between the two Panama City readers and the reference ages was 1.6%. Generally in a production ageing setting, an APE ≤5% is considered acceptable for moderately long-lived species with relatively difficult to read otoliths (Morison et al., 1998; Campana, 2001).

RESULTS/DISCUSSION

<u>Collections</u>

A total of 1,388 greater amberjack otoliths were collected primarily from 2009 through 2012 (1 otolith collected in 1997). The RECFIN program sampled 68% of otoliths followed by the TIP program with 21% (Table 1). As a result, the majority of greater amberjack sampled came from the recreational fishery, specifically from the charter boat fishery (46%; Table 2). The gear type recorded most often was hand-line (96%) with small numbers of long-line and spear recorded. Florida landings accounted for 79% of greater amberjack sampled.

<u>Size frequency</u>

Size frequency distributions can provide some indication of the underlying age structure and differences were noted in the sizes of greater amberjack by fishing mode. Undersized fish were recorded from the commercial and recreational fisheries. Sampling programs were contacted and corrections made if there was a recording error in length. Some of these undersized fish were retained through permits (e.g., Will Ward CRP project, FWRI by-catch study), however some undersized fish appear to have been retained without permit. According to some samplers, undersized fish are often retained in the recreational fishery (Bill Walling and Gregg Bray, personal communication).

The commercial fishery was comprised of the largest individuals with modes in the 1001-1050 and 1151-1150 mm FL size range and mean sizes of 977 and 972 (mm) FL (996 and 1094 (mm) FL for legal only fish) for hand-line and long-line respectively (Fig. 1A). However, few long-line fish were collected (N= 27). Recreational caught fish tended to be smaller, probably partially due to the lower size limit for recreational fish (30 inches FL recreational vs. 36 inches FL commercial; Fig. 1B). The dominant size-class for the recreational fishery was 801-850 (mm) FL with a mean size of 858 mm FL (879 (mm) FL for legal fish). Very few fishery-independent fish were collected (N= 39) with most hand-line fish below the recreational size limit (mean = 530 mm; Fig. 1C).

A sex was recorded most often for the recreational fishery, since most commercially caught fish are eviscerated at sea (Fig. 2). Females ranged in size from 461 to 1270 mm FL and males from 352 to 1190. Females averaged 868 mm FL and Males 852 mm FL with no significant difference between sizes by sex (ANOVA: P= 0.09).

<u>Age frequency</u>

Greater amberjack ages ranged from young-of-year to 9 yrs. We were able to successfully assign an age to 93% of otoliths read. The remainder of the otoliths were unreadable due to a diffuse banding pattern or preparation problems (i.e., too thick or thin or sectioned off the core). A comparison of age distributions by fishing mode indicated difference in age structure. The commercial fishery selected the oldest ages with a mode at age 4 and average age of 4.4 yrs. (4.5 yrs. for legal only fish) for hand-line and 4.1 for the few long-line ages (N= 15; Fig 3A). The recreational fishery selected for younger fish with 81% of ages either 3 or 4 yrs. and a mean age of 3.5 yrs. (3.6 yrs. for legal only fish; Fig. 3B). Fishery-independent hand-line collected the youngest fish, with a mean age of 2.7 yrs. and 3.5 yrs. for the few observations from fishery-independent long-line (N= 13; Fig. 3C).

Males and females aged from the recreational fishery ranged from 1 to 6 and 1 to 7 yrs. respectively (Fig. 4). Modal age was 4 yrs. for both sexes and mean age was similar (3.6 yrs. for females and 3.5 yrs. for males). No significant difference for mean age by sex was found (ANOVA: P=0.58).

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Table 1. Number of otoliths processed and assigned an age (in parentheses) during the years 1997 and 2009 through 2012. CO-OP = Cooperative research program, CSSP= Congressional supplemental survey program, GOP= Galveston observer program, HB = Head boat program, MRFSS= Marine recreational statistical survey, MSLAB= Mississippi lab, PCLAB= Panama City lab, RECFIN= Recreational fisheries information network and TIP= Trip interview program.

STATE	**YEAR**	**CO-OP**	**CSSP**	**GOP**	**HB**	**MRFSS**	MSLAB	**PCLAB**	**RECFIN**	**TIP**	**TOTAL**
Alabama	**2009**										
	2010										
	2011		7 (7)								7 (7)
	2012										
Florida	**2009**	3 (3)			13 (11)	7 (7)		2 (2)	173 (160)	11 (11)	209 (194)
	2010				6 (6)	5 (2)			302 (277)	5 (5)	318 (290)
	2011		1		8 (8)	8 (8)	1 (1)	4 (4)	208 (196)	21 (20)	251 (237)
	2012			3 (3)				55 (45)	255 (250)	8 (8)	321 (306)
Louisiana	**2009**									73 (66)	73 (66)
	2010									42 (36)	42 (36)
	2011		13 (12)		4 (4)					49 (46)	66 (62)
	2012									87 (86)	87 (86)
Texas	**1997**				1 (1)						1 (1)
	2009										
	2010										
	2011		9 (8)								9 (8)
	2012				4 (4)						4 (4)
	TOTAL	3 (3)	30 (27)	3 (3)	36 (34)	20 (17)	1 (1)	61 (51)	938 (883)	296 (278)	1,388 (1,297)

Table 2. Number of otoliths processed and assigned an age (in parentheses) during the years 1997 and 2009 through 2011. HL= hand-line, LL= long-line and SP= spear.

		Commercial		**Charter**	**Headboat**	**Private**		**Fishery-indep.**		**Tournament**		**TOTAL**
STATE	**YEAR**	**HL**	**LL**	**HL**	**HL**	**HL**	**SP**	**HL**	**LL**	**HL**	**SP**	
Alabama	**2009**											
	2010											
	2011							5 (5)	2 (2)			7 (7)
	2012											
Florida	**2009**	3 (3)	11 (11)	51 (48)	139 (127)	3 (3)		2 (2)				209 (194)
	2010	3 (3)	2 (2)	168 (149)	134 (126)	4 (3)	7 (7)					318 (290)
	2011	9 (9)	12 (11)	134 (133)	80 (69)	9 (9)	1 (1)	3 (3)	1	2 (2)		251 (237)
	2012	11 (11)		285 (273)	12 (12)			4 (2)		2 (1)	7 (7)	321 (306)
Louisiana	**2009**	73 (66)										73 (66)
	2010	40 (35)	2 (1)									42 (36)
	2011	49 (46)			4 (4)			2 (2)	11 (10)			66 (62)
	2012	87 (86)										87 (86)
Texas	**1997**				1 (1)							1 (1)
	2009											
	2010											
	2011							8 (7)	1 (1)			9 (8)
	2012				4 (4)							4 (4)
	TOTAL	275 (259)	27 (25)	638 (603)	374 (343)	16 (15)	8 (8)	24 (21)	15 (13)	4 (3)	7 (7)	1,388 (1,297)

Figure 1. Greater amberjack length frequencies by sector: A) commercial, B) recreational and C) fishery-independent survey with number of observations and mean fork length.

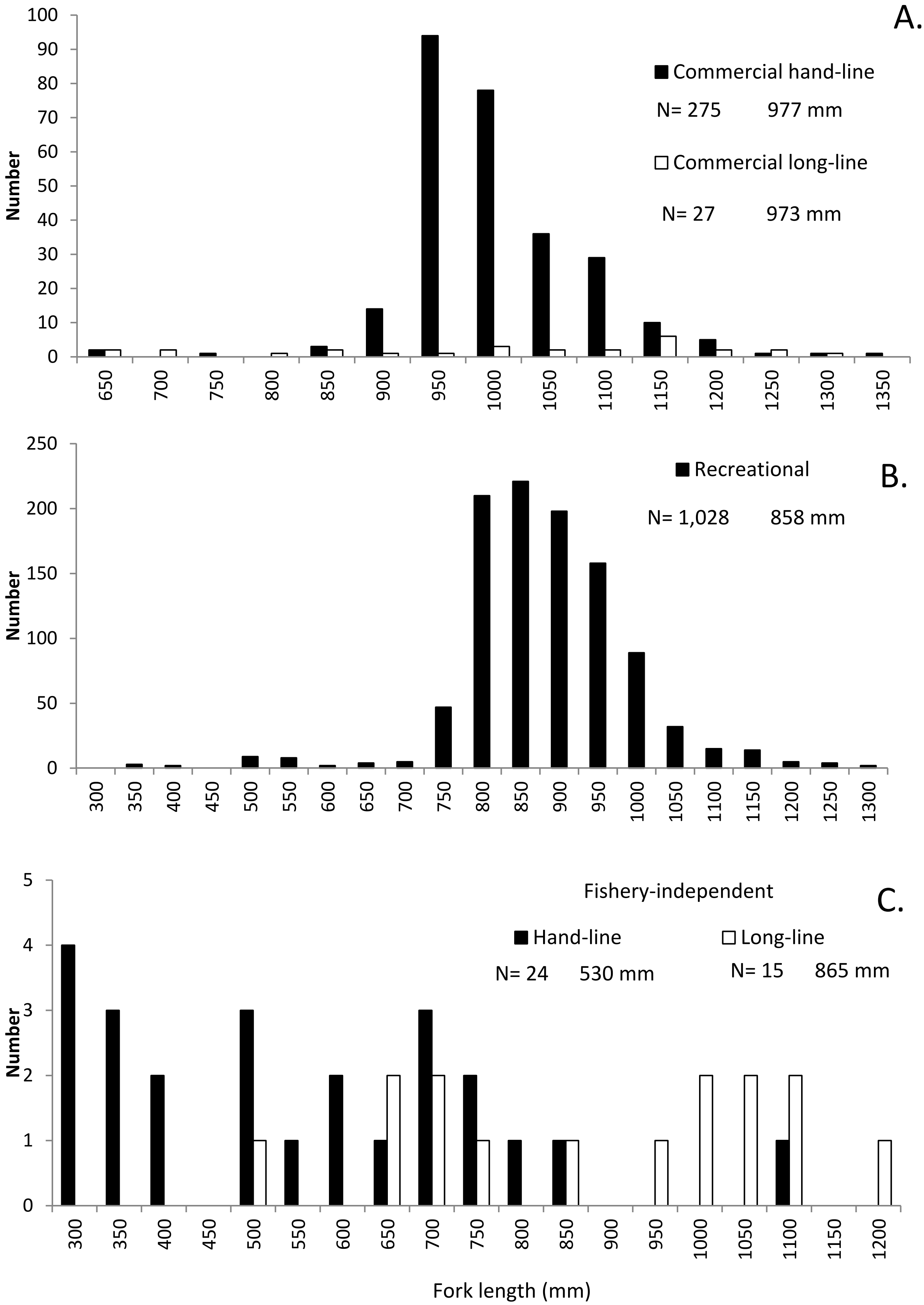

Figure 2. Greater amberjack length frequencies for the recreational fishery by sex with number of observations and mean fork length.

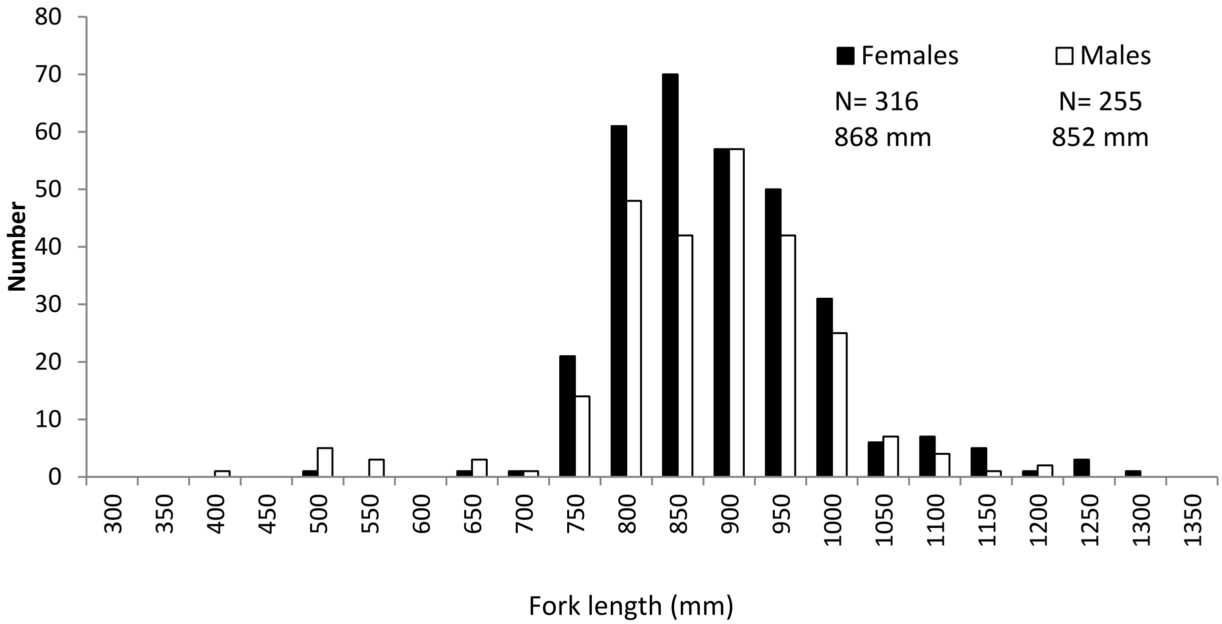

Figure 3. Greater amberjack age frequencies by sector: A) commercial, B) recreational and C) fishery-independent survey with number of observations and mean age.

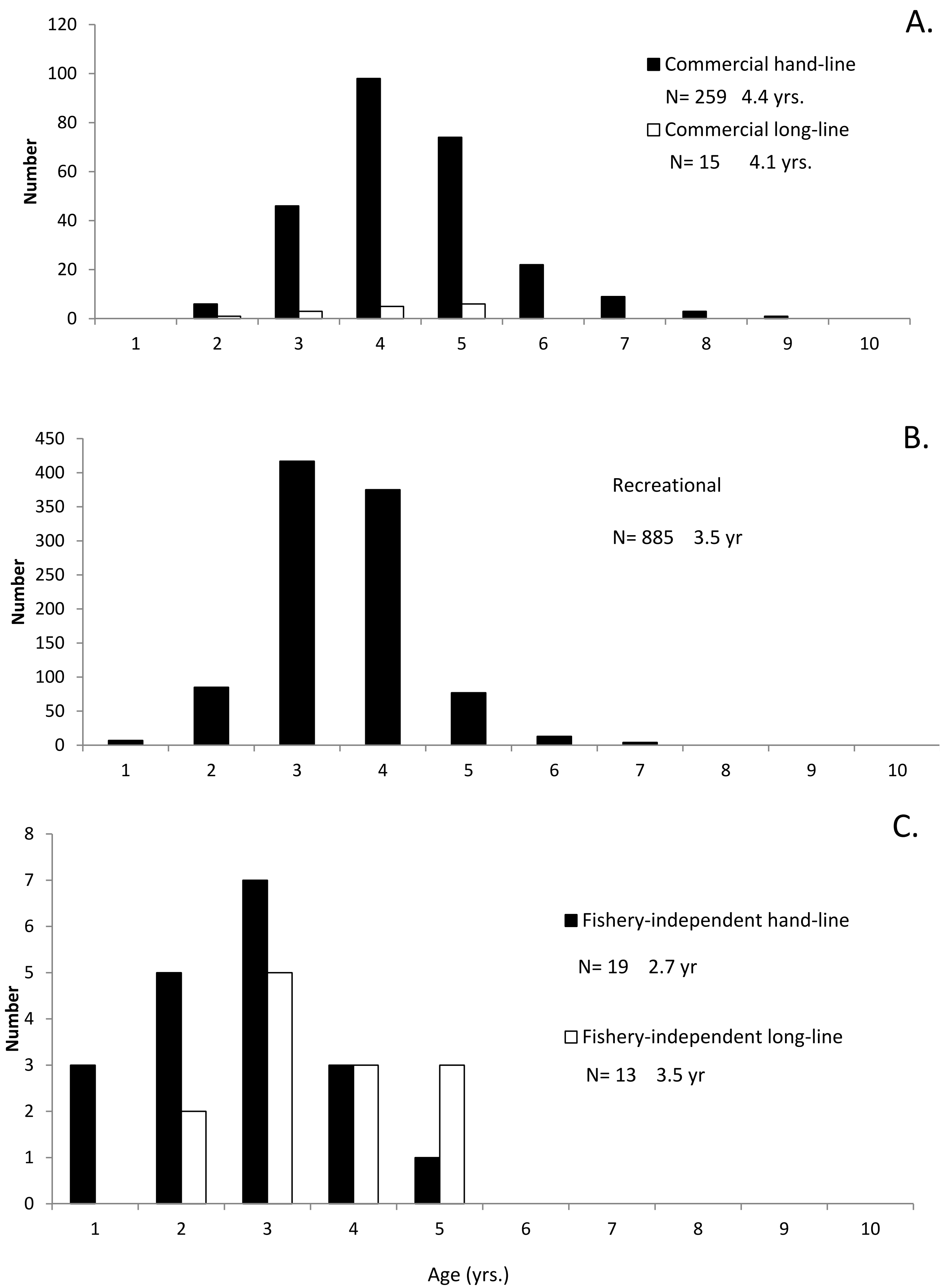

Figure 4. Greater amberjack age frequencies for the recreational fishery by sex with number of observations and mean age.