Size and age composition of red snapper, *Lutjanus campechanus*, collected in association with fishery-independent and fishery-dependent projects off of Florida's Atlantic coast during 2012 and 2013

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SEDAR41-DW09

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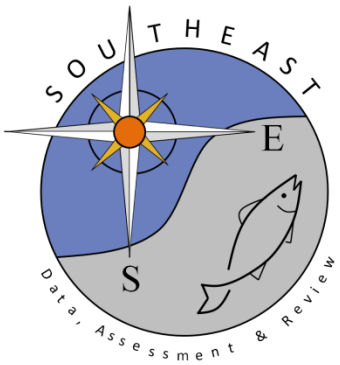

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Size and age composition of red snapper, *Lutjanus campechanus*, collected in association with fishery-independent and fishery-dependent projects off of Florida's Atlantic coast during 2012 and 2013

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Introduction:

The U.S. South Atlantic red snapper *Lutjanus campechanus* fishery has been active since the 1950s, with a substantial proportion of landings recorded along the Atlantic coast of Florida. Following peak annual red snapper landings during the 1970s, landings markedly declined (White and Palmer 2004). Declines in landings from commercial, recreational, and headboat fisheries from 1986 to 1995 were also documented by Manooch et al. (1998) as part of the first formal assessment of the U.S. South Atlantic red snapper stock. Results from a 2008 South East Data Assessment and Review (SEDAR) stock assessment indicated that the stock was overfished and experiencing overfishing (SEDAR 15 2008). In response to this assessment, the South Atlantic Fishery Management Council implemented an emergency closure of the commercial and recreational red snapper fishery throughout federal waters (3 to 200 miles offshore) in the U.S. South Atlantic region in 2010. Results from an updated assessment in 2010 indicated that the red snapper stock had benefited from two strong recruitment year classes in 2006 and 2007 (SEDAR 24 2010), although the fishing closure has largely remained in place aside from some very limited harvest in 2012 and 2013.

Because the harvest of red snapper has largely been prohibited from 2010 onward, there is a relative paucity of life history data for red snapper in recent years. The recently-expanded SouthEast Reef Fish Survey, which utilizes chevron traps, has been able to provide some life history data for red snapper. To augment these data, the state of Florida's Fish and Wildlife Research Institute has collected life history samples from red snapper collected in association with fishery-independent and fishery-dependent research and monitoring activities along the Atlantic coast of Florida.

Fishery-Independent Sources of Life History Data:

Life history samples for red snapper were collected along the Atlantic coast of Florida in association with two fishery-independent research and monitoring projects. Most life history samples were collected in 2012 in association with a one-year pilot study to explore the utility of various fishery-independent, hooked-gear methods (vertical longlines, short bottom longlines, and repetitive active fishing surveys) to provide data for red snapper and other managed reef fishes (SEDAR41-DW08). This survey implemented a stratified-random survey design in which monthly sampling sites (April – October) were randomly selected within three latitudinal strata (statistical reporting zones 722, 728, and 732) and two depth strata (0 – 30 m and 30 – 200 m; Figure 1). Additional life history samples were collected in 2012 and 2013 in association with a three-year tagging study to examine movement of red snapper (SEDAR41-DW10). Sampling sites were not randomly selected, but rather chosen by cooperative fishing partners to maximize the number of red snapper tagged (Figure 2). During both studies red snapper were culled for life history analyses following two methods. Most individuals were culled following randomization procedures (random culls); however, some larger individuals (> 700 mm TL) that would have otherwise been released were also culled (nonrandom culls) to better characterize the age composition of larger and, presumably, older red snapper. Additional survey details can be found in SEDAR41-DW08 and SEDAR41-DW10.

Fishery-Dependent Sources of Life History Data:

Life history samples for red snapper were collected along the Atlantic coast of Florida in association with several fishery-dependent research and monitoring projects, including increased sampling efforts during the limited recreational and commercial harvest seasons in 2012 and 2013. Since fish must be returned quickly during fishery-dependent surveys, priority was given to collecting the left otolith of both otoliths could not be removed.

Recreational Private Boat Fishery:
During the 2012 and 2013 red snapper mini-seasons, sites adjacent to major inlets from Cumberland Sound to Port St. Lucie that provide ocean access to red snapper fishing grounds were randomly selected for access point intercept surveys. Parties returning from offshore recreational boat-based fishing trips were intercepted, and all available red snapper were measured (at midline in mm), weighed (kg), and an otolith was extracted. Fishing effort from each inlet was also estimated; effort estimates may be used to apply sample weights to aged fish. The survey design and sample weighting methods are documented in two reference documents (SEDAR41-RD14 and SEDAR41-RD15).

In addition, red snapper were targeted for biological sampling at private boat landing sites, including fish cleaning stations and boat ramps. Sites were not randomly selected, and boats were sampled in the order they arrived. Biologists did not target any particular size of fish. Private recreational anglers also donated red snapper carcasses at select locations on the east coast of Florida during the 2012 and 2013 mini-seasons. It is impossible to determine whether or not donated carcasses are biased or representative of the harvested population. Nevertheless, data from targeted biological sampling and carcass donations may be able to provide supplementary size-at-age data for older fish and fish caught from deeper depths that are rare in other randomly-selected, fishery-dependent samples (SEDAR41-RD15).

Recreational Charter and Headboat Fisheries:
During 2012 and 2013 mini-seasons, red snapper were sampled at charter and headboat landing sites from Cumberland Sound to Port St. Lucie. Sampling sites were not randomly selected; instead, biologists went to sites where red snapper trips were known to occur because of the short window of opportunity to collect samples. Red snapper trips were sampled in the order that vessels arrived. Biologists did not target any particular size of fish. During the 2012 and 2013 mini-seasons, charter and headboat vessel operators and clients were also allowed to donate red snapper carcasses at select locations. As mentioned previously, it is impossible to determine whether or not donated carcasses are biased or representative of the harvested population

Since 2005, headboat vessels have been randomly selected for observer coverage in Florida, Georgia, South Carolina and North Carolina; vessels are selected weekly throughout the year. Otoliths are not collected as part of this survey; however, length frequencies for both harvested and discarded red snapper have been summarized (SEDAR41-DWxx). In 2013, FWC received a three-year MARFIN grant to place fishery observers on charter fishing vessels. Cooperative charter vessels were randomly selected weekly throughout the year, and all red snapper caught during sampled trips were measured (midline in mm). For charter trips sampled during the three-day recreational season in 2013, otoliths were extracted from harvested red snapper. Length frequency data from both observer programs will be made available to the Life History Workgroup.

Commercial TIP Sampling:
During the limited commercial seasons in 2012 and 2013, vessels were limited to a maximum gutted weight (2012 – 50 lbs and 2013 – 75 lbs) of red snapper landed during each season. FWC commercial samplers visited commercial fish houses during the commercial season and actively looked for landed red snapper to sample. Fish were sampled as they were offloaded from the vessels with no preference for size. Effort and trip information was also collected, including commercial zone fished, depth, and gear used. All effort and biological data were entered into the Trip Intercept Program (TIP) website.

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 Buhler Isomet low speed saw that was equipped with four equally-spaced diamond wafering blades. With this multi-blade technique, one transverse cut yields three ~400 μm thick sections that encompass both the core and the entire region surrounding the core (Vanderkooy 2009). After processing, sections were mounted on glass slides with Flo-texx, a chemical mounting media.

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 (Jerald 1983; VanderKooy 2009). Previous studies have found that red snapper off the Southeastern US complete annulus formation by late spring to early summer (Wilson and Nieland 2001; White and Palmer 2004, Allman, et al. 2005). 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 example, a fish caught in spring with 3 complete annuli and a large translucent zone would be assigned an age of 4, since there is an expectation that annulus deposition would have happened soon had the fish not been captured. For all fish collected after June 30, age was assigned to be annulus count, since opaque zone formation is typically complete (Allman, et al. 2005).

Four readers aged the collection of otoliths from FWRI sampling on the East Coast of Florida (n=1,452). Prior to ageing these samples, each reader read through an in-house reference set of red 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. Readers were assigned different portions of the collection, with a 94% age agreement between all first and second reads.

Fishery-Independent Results:

All fishery-independent age data have been independently provided to the life history workgroup; what follows is a summary of aged red snapper. Age data are summarized for a total of 1,437 red snapper for which ages were obtained, including 1,307 individuals (1,304 random and 3 nonrandom culls) collected during the fishery-independent hooked-gear study and 130 individuals (107 random and 23 nonrandom culls) collected during the tagging study.

Ages of individuals collected during the fishery-independent study, which covered a broad geographic area (Figure 1), ranged from 1 to 21 years of age, although 90% of individuals were six years old or younger (Figure 3). The age distribution was bimodal, with exceptionally high numbers of age-3 and age-5 red snapper, corresponding to the 2009 and 2007 year classes, respectively. Maximum size at age was just over 800 mm TL at approximately 8 – 10 years of age. Ages of individuals collected during the tagging study, which were restricted spatially (Figure 2), ranged from 1 to 16 years of age (Figure 4). Individuals that were nonrandomly culled were typically older and larger than those that were randomly culled. Maximum size at age was similar to that observed from the fishery-independent study. No notable differences in age distribution or size at age were evident between males and females for either the fishery-independent (Figure 5) or tagging study (Figure 6), although the two oldest fish aged were both males. An examination of age-specific depths of capture did not identify a significant increase in depth with age in either the fishery-independent or tagging study (Figure 7); the two oldest fish were collected in generally deeper waters (> 40 m), but these depths were well within the depth limits of the fishery-independent study (200 m).

Fishery-Dependent Results:

All fishery-dependent age data have been independently provided to the life history workgroup; what follows is a summary of aged red snapper. Age data are summarized for a total of 3,585 individuals for which ages were obtained. The majority of age samples were obtained from surveys of the private recreational (1,363 samples) and charter sectors (975 samples), although samples were also obtained from the commercial (400 samples) and headboat sectors (554 samples) as well as in association with various fishing tournaments (293 samples). Approximately 47% (1,694 samples) of red snapper were unsexed.

Overall, results largely mirrored those from the fishery-independent surveys. There were some notable differences in age-frequency distribution among the various fishing sectors surveyed. Notably, both the commercial (Figure 8) and headboat fishery (Figure 9) generally targeted younger red snapper; the vast majority of individuals sampled from the headboat fishery in particular were age-3 or younger. Red snapper sampled from the charter fishery (Figure 10), private recreational fishery (Figure 11), and in association with fishing tournaments (Figure 12) were all somewhat older, although the vast majority of red snapper were still age-8 or younger. Very few older fish were sampled, although a maximum age of 29 was observed from an unsexed individual obtained during a fishing tournament. Overall, maximum size at age levels off at just over 800 mm TL for all sectors, and there were no discernible differences in age structure or size at age by sex (Figures 8 – 12).

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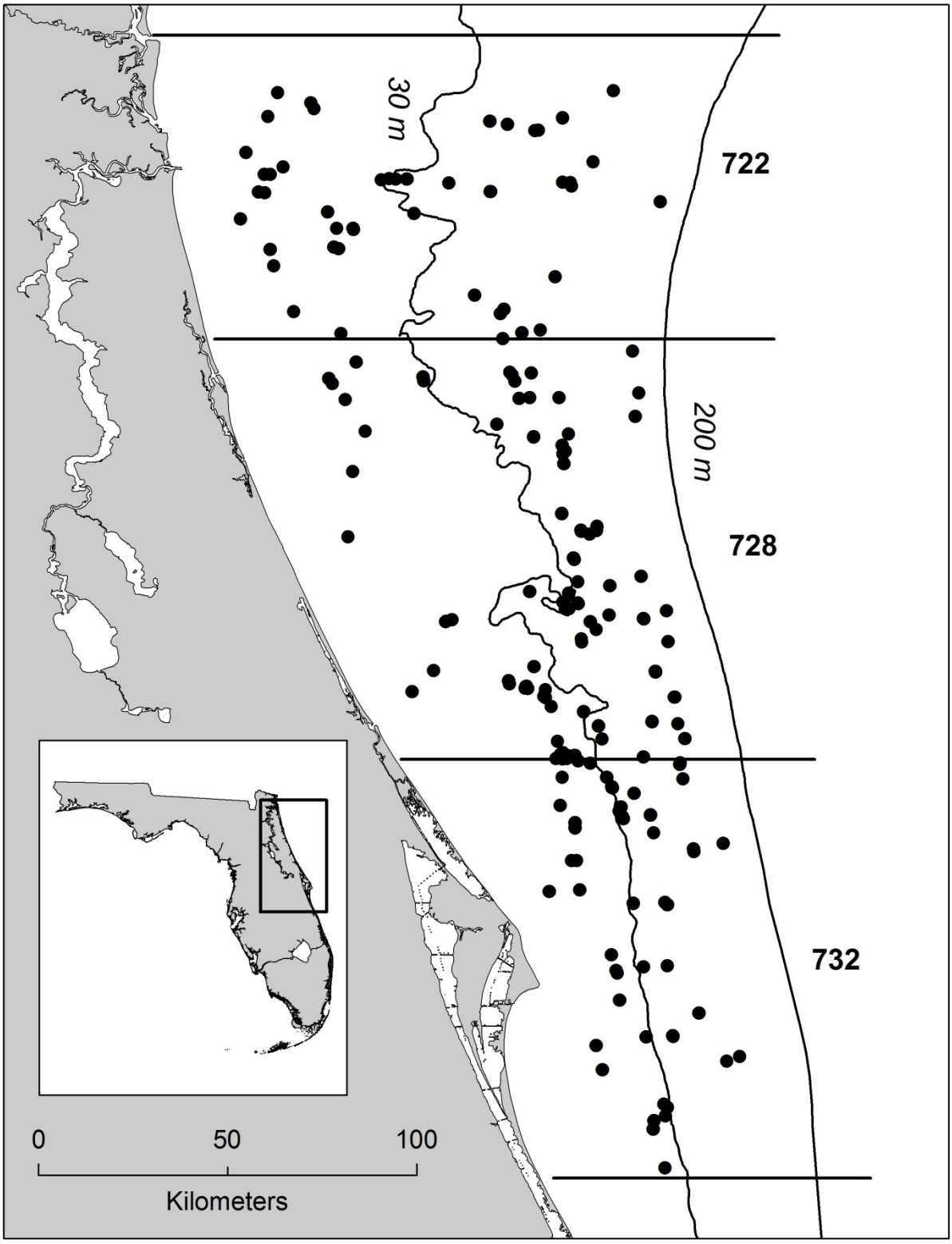

Figure 1. Locations of red snapper life history samples collected as part of a one-year pilot study on the utility of fishery-independent hooked gears conducted in 2012.

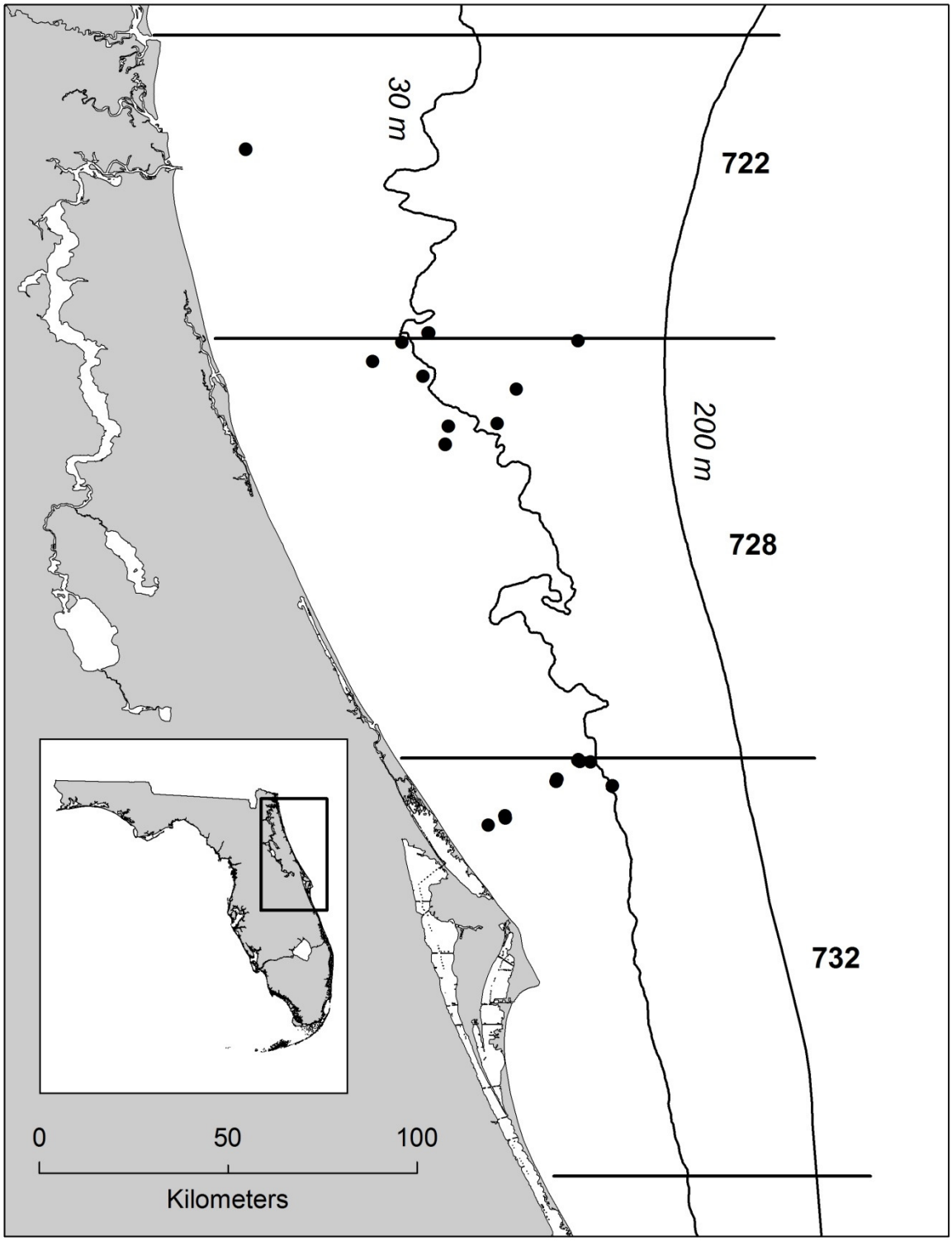

Figure 2. Locations of red snapper life history samples collected as part of a three-year tagging study on the movement of red snapper. Sampling was conducted from 2011 – 2013, although life history samples were only collected in 2012 and 2013.

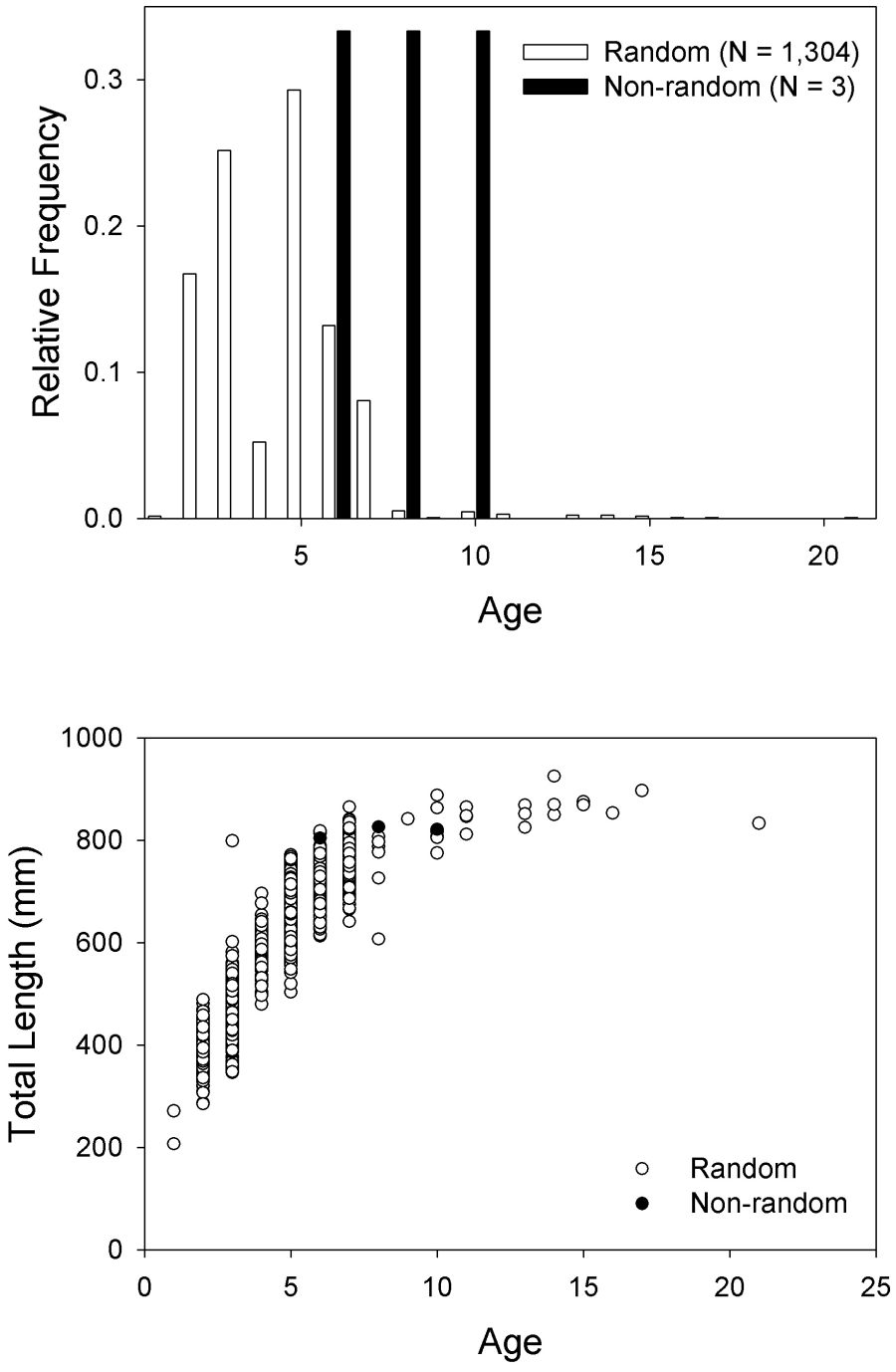

Figure 3. Summaries of age-frequency distributions (upper panel) and size at age (lower panel) for red snapper collected in association with fishery-independent hooked-gear surveys conducted in 2012.

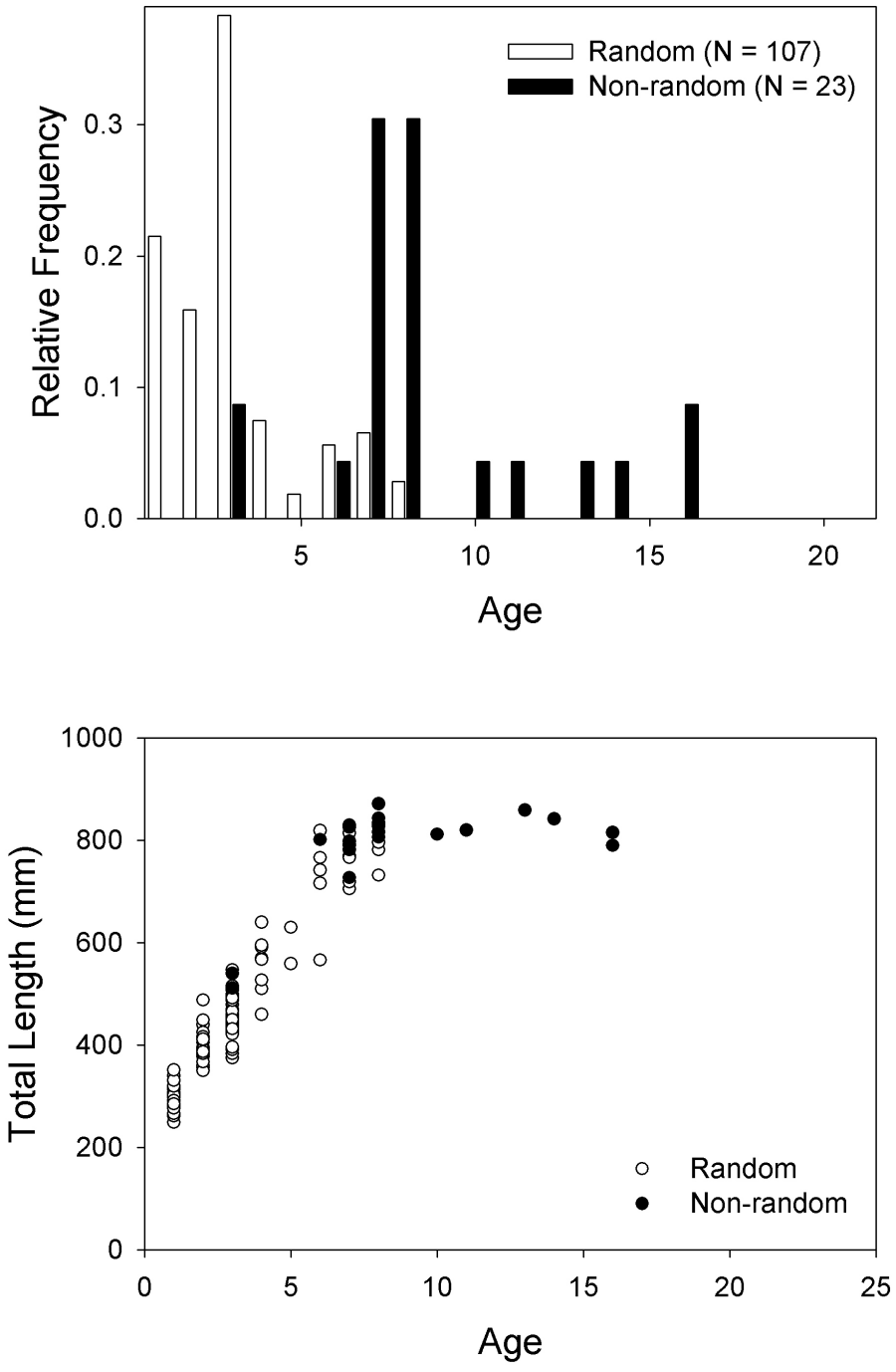

Figure 4. Summaries of age-frequency distributions (upper panel) and size at age (lower panel) for red snapper collected in association with a tagging study conducted in 2012 and 2013.

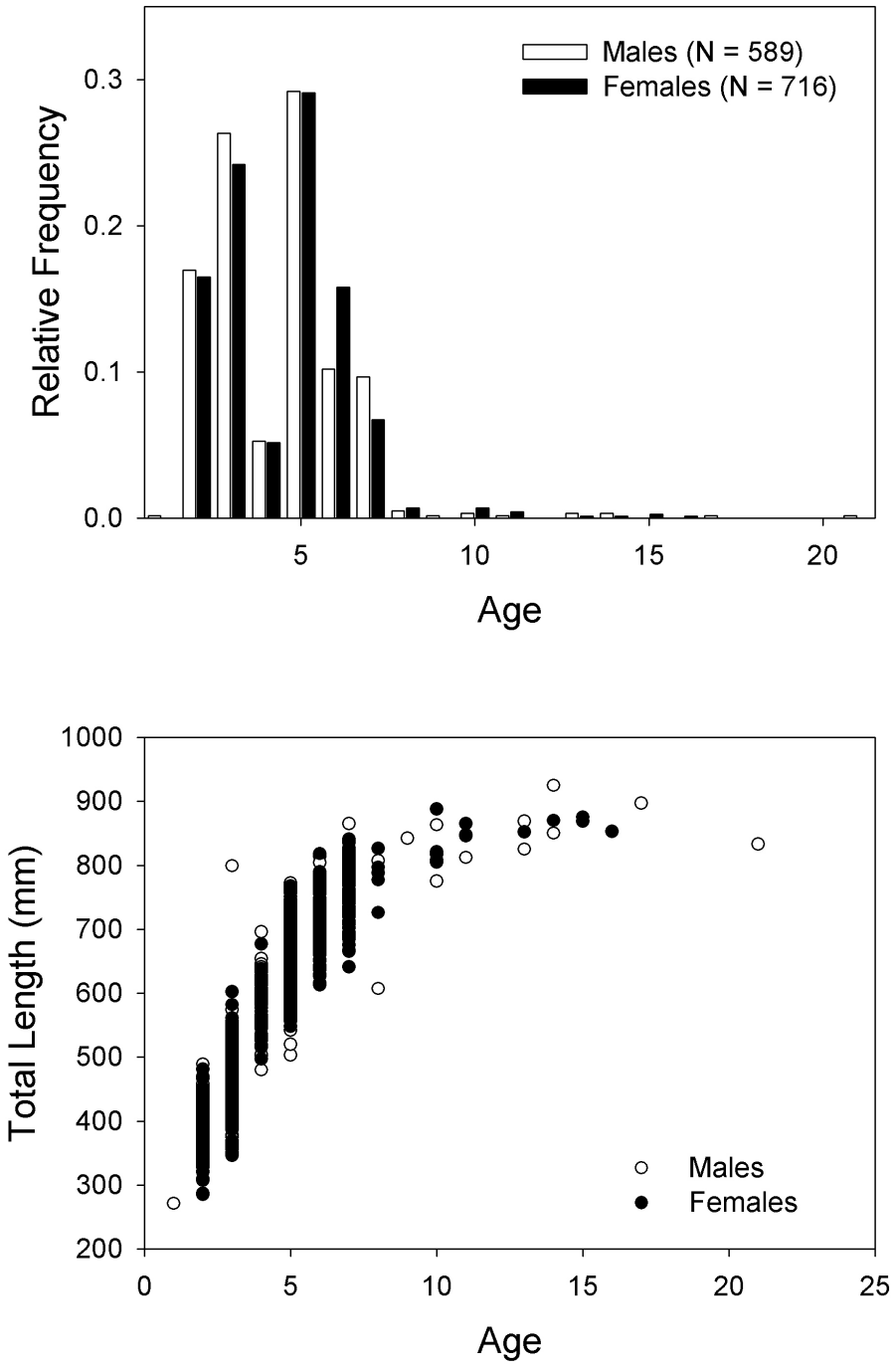

Figure 5. Summaries of age-frequency distributions (upper panel) and size at age (lower panel) by sex for red snapper collected in association with fishery-independent hooked-gear surveys conducted in 2012. Note that these plots include both randomly and non-randomly culled red snapper.

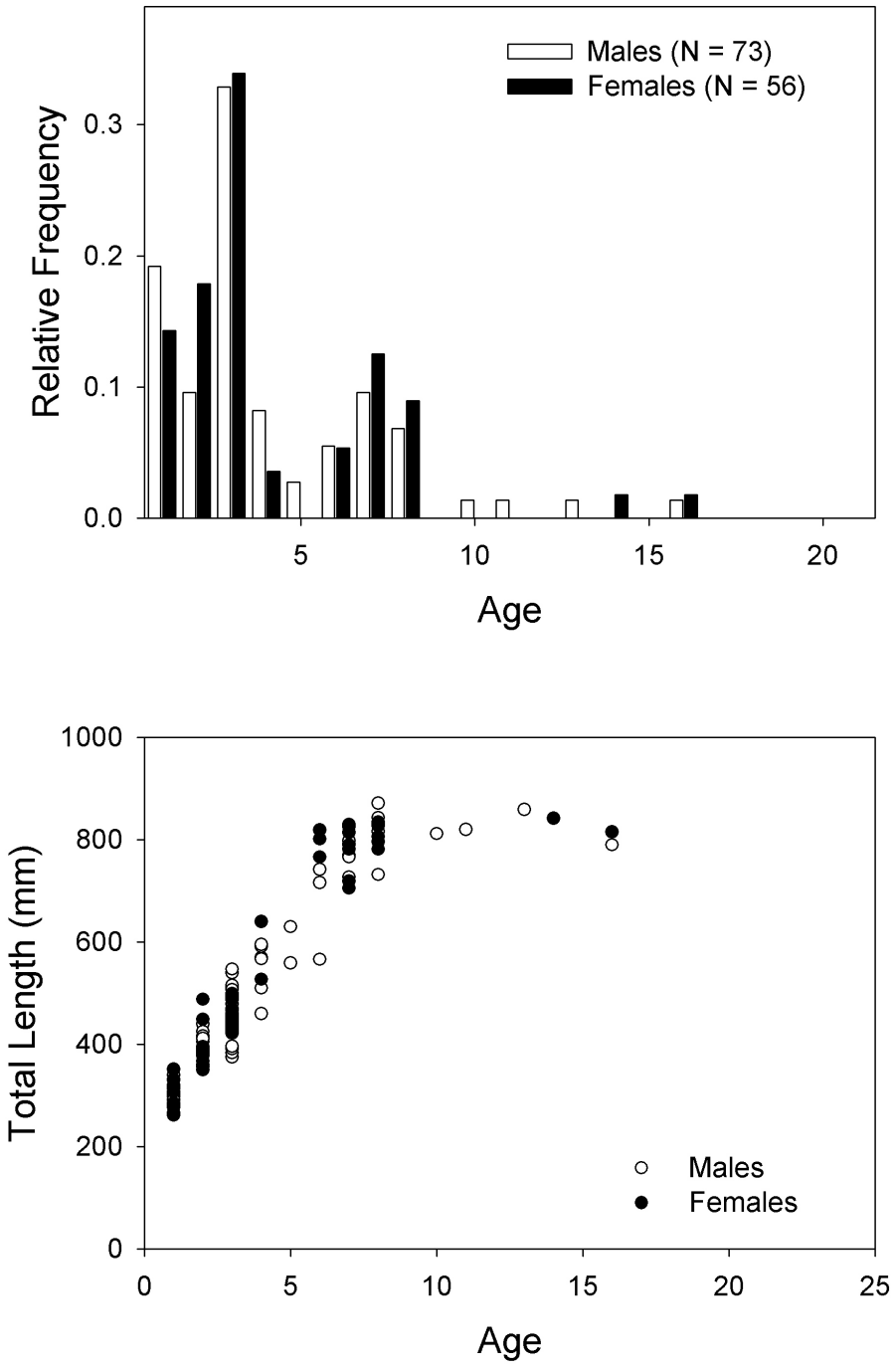

Figure 6. Summaries of age-frequency distributions (upper panel) and size at age (lower panel) by sex for red snapper collected in association with a tagging study conducted in 2012 and 2013. Note that these plots include both randomly and non-randomly culled red snapper.

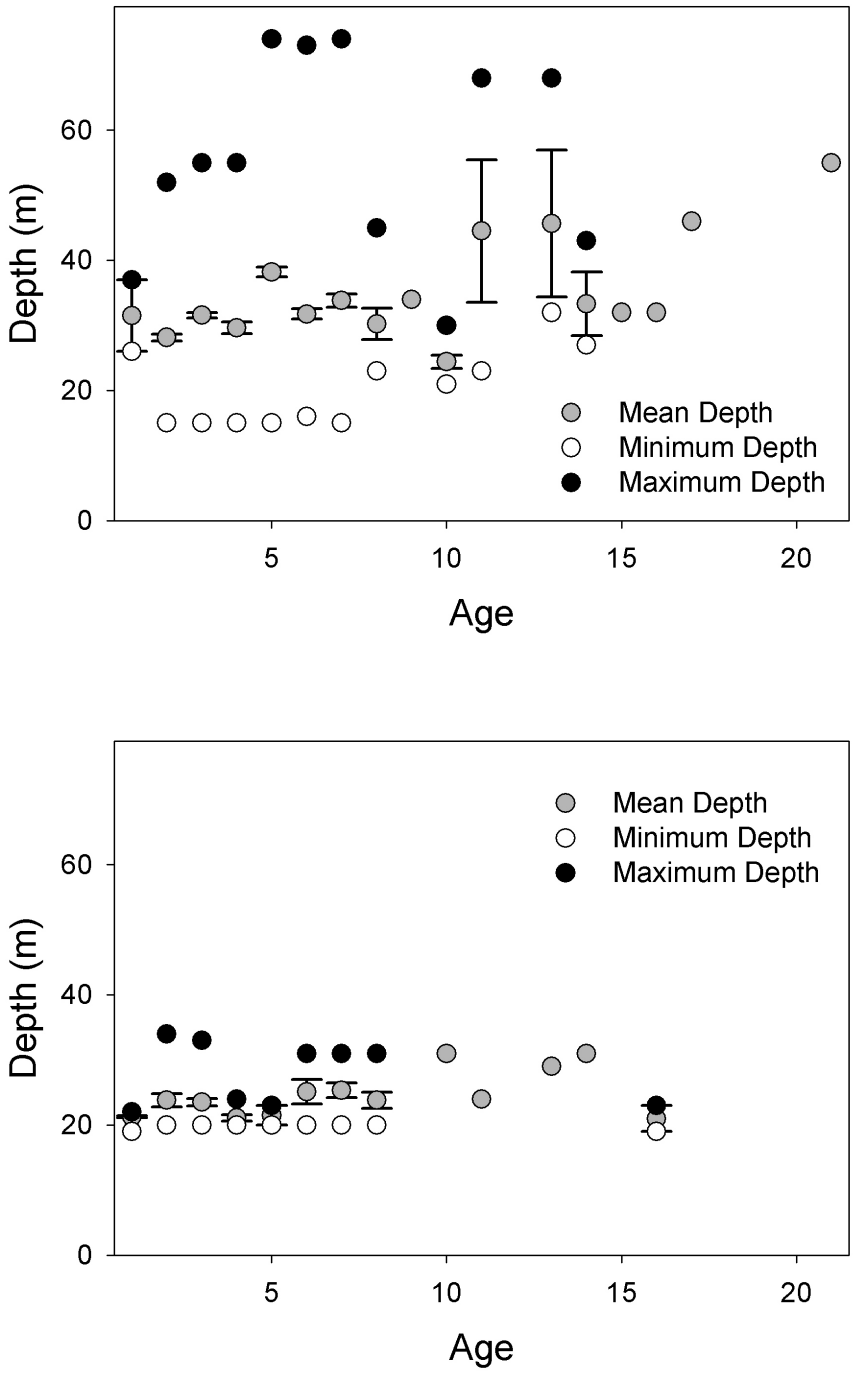

Figure 7. Summary of mean (± SE), minimum, and maximum depths (m) of capture by age for red snapper collected in association with fishery-independent hooked-gear surveys conducted in 2012 (upper panel) and a tagging study conducted in 2012 and 2013 (lower panel).

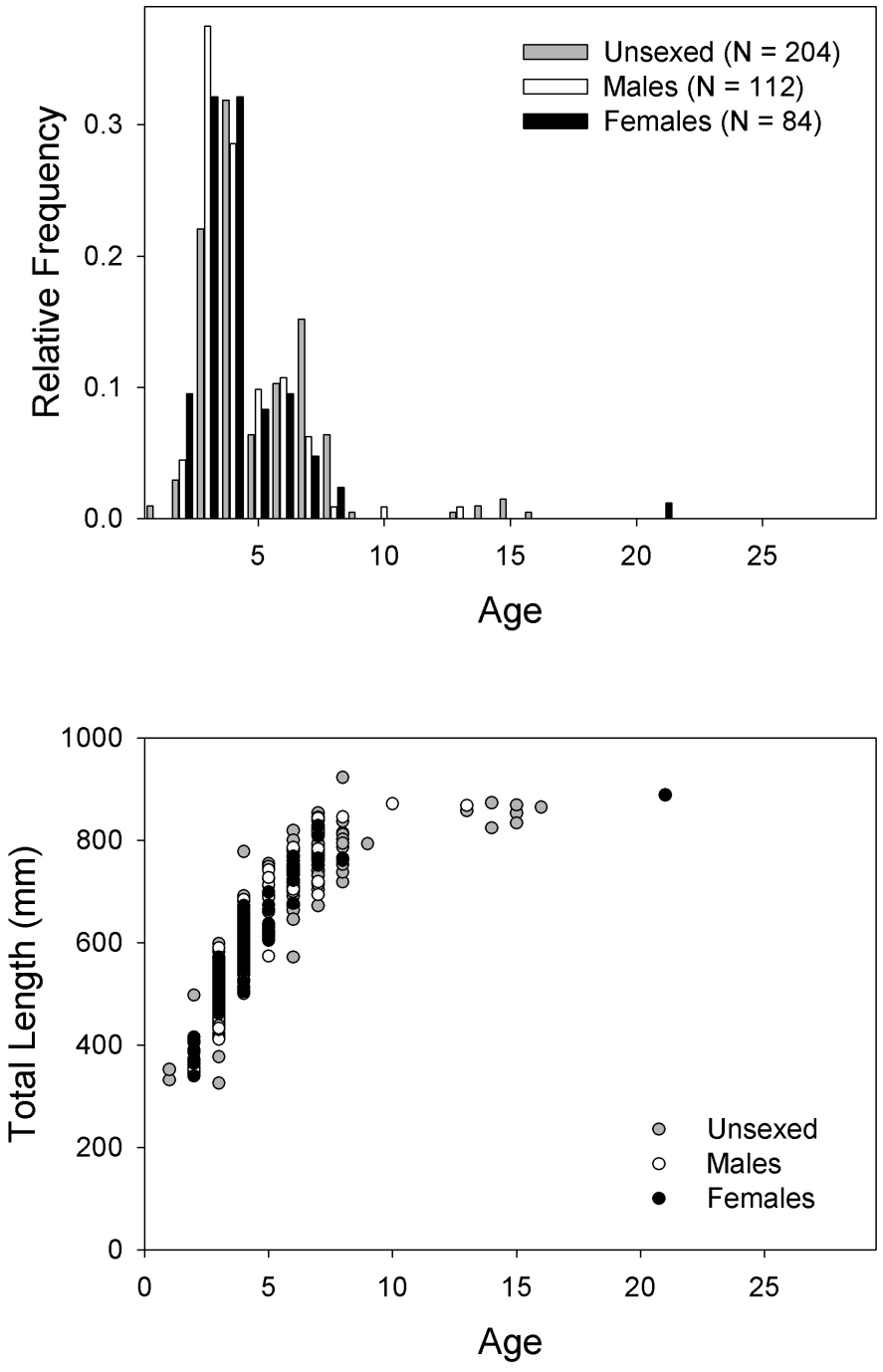

Figure 8. Summaries of age-frequency distributions (upper panel) and size at age (lower panel) by sex for red snapper collected in association with fishery-dependent surveys of the commercial fishery conducted in 2012 and 2013.

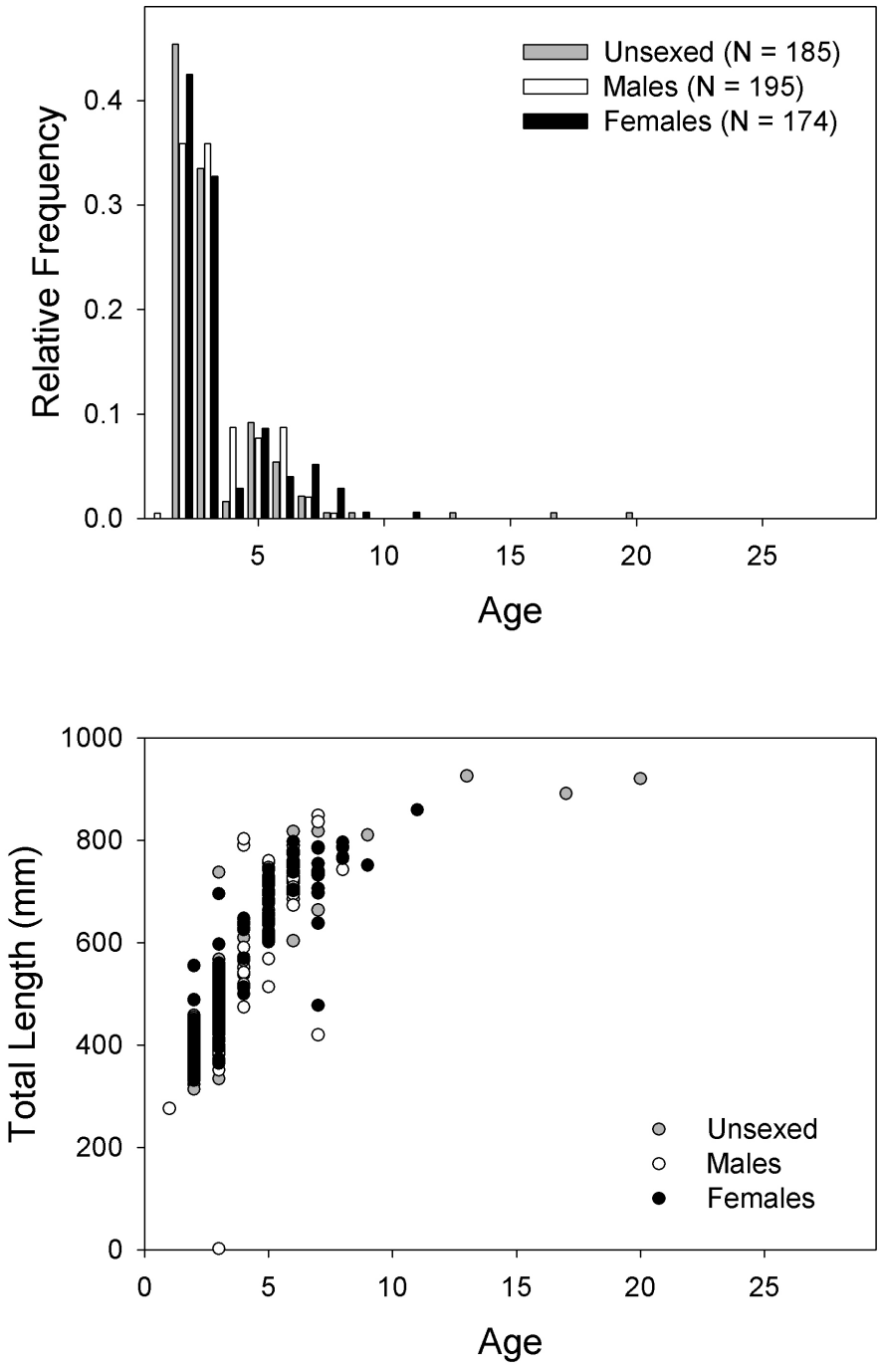

Figure 9. Summaries of age-frequency distributions (upper panel) and size at age (lower panel) by sex for red snapper collected in association with fishery-dependent headboat surveys conducted in 2012 and 2013.

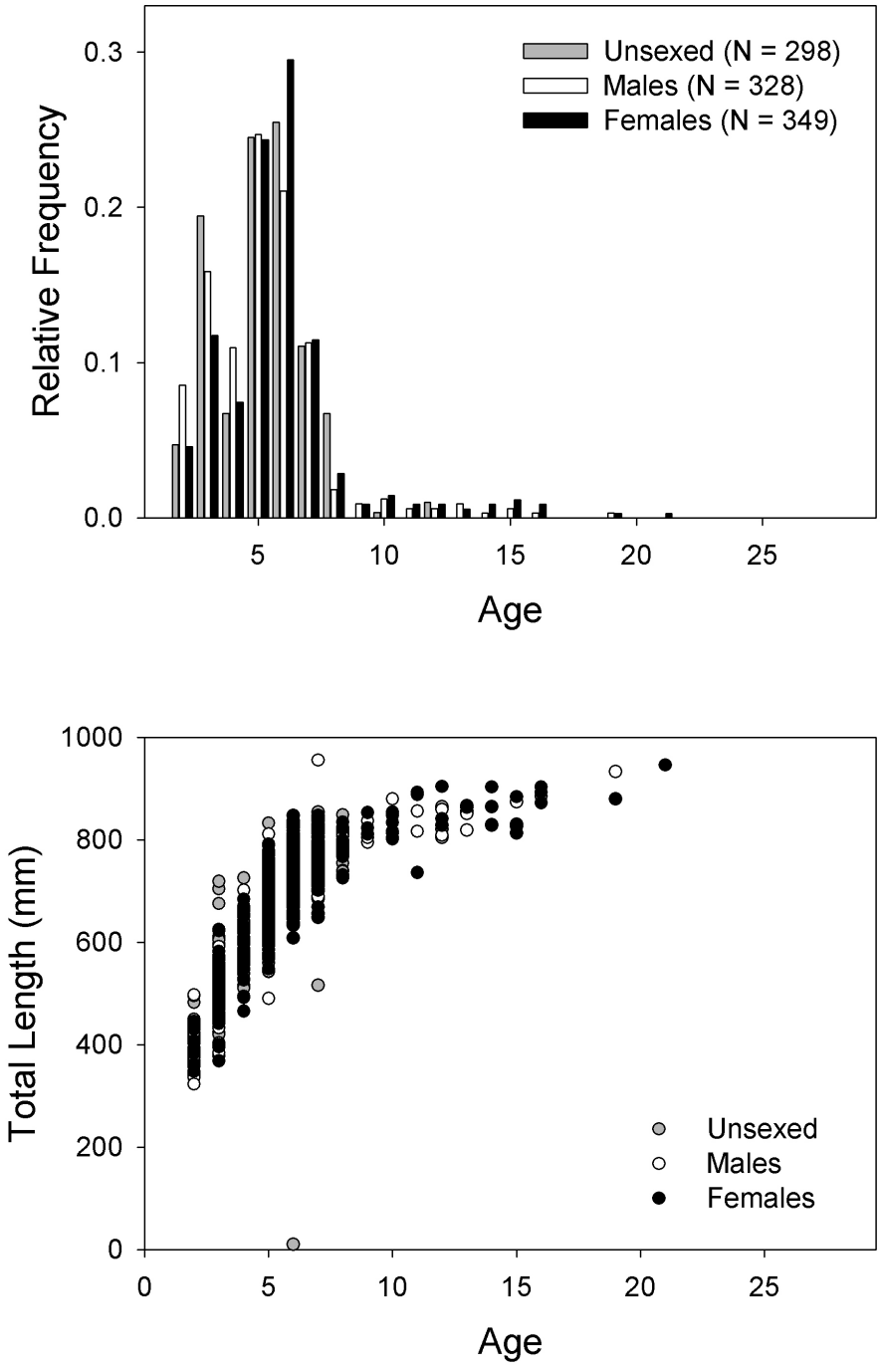

Figure 10. Summaries of age-frequency distributions (upper panel) and size at age (lower panel) by sex for red snapper collected in association with fishery-dependent surveys of the charter fishing industry conducted in 2012 and 2013. Note that these plots include samples obtained through targeted biological sampling and volunteer carcass donations.

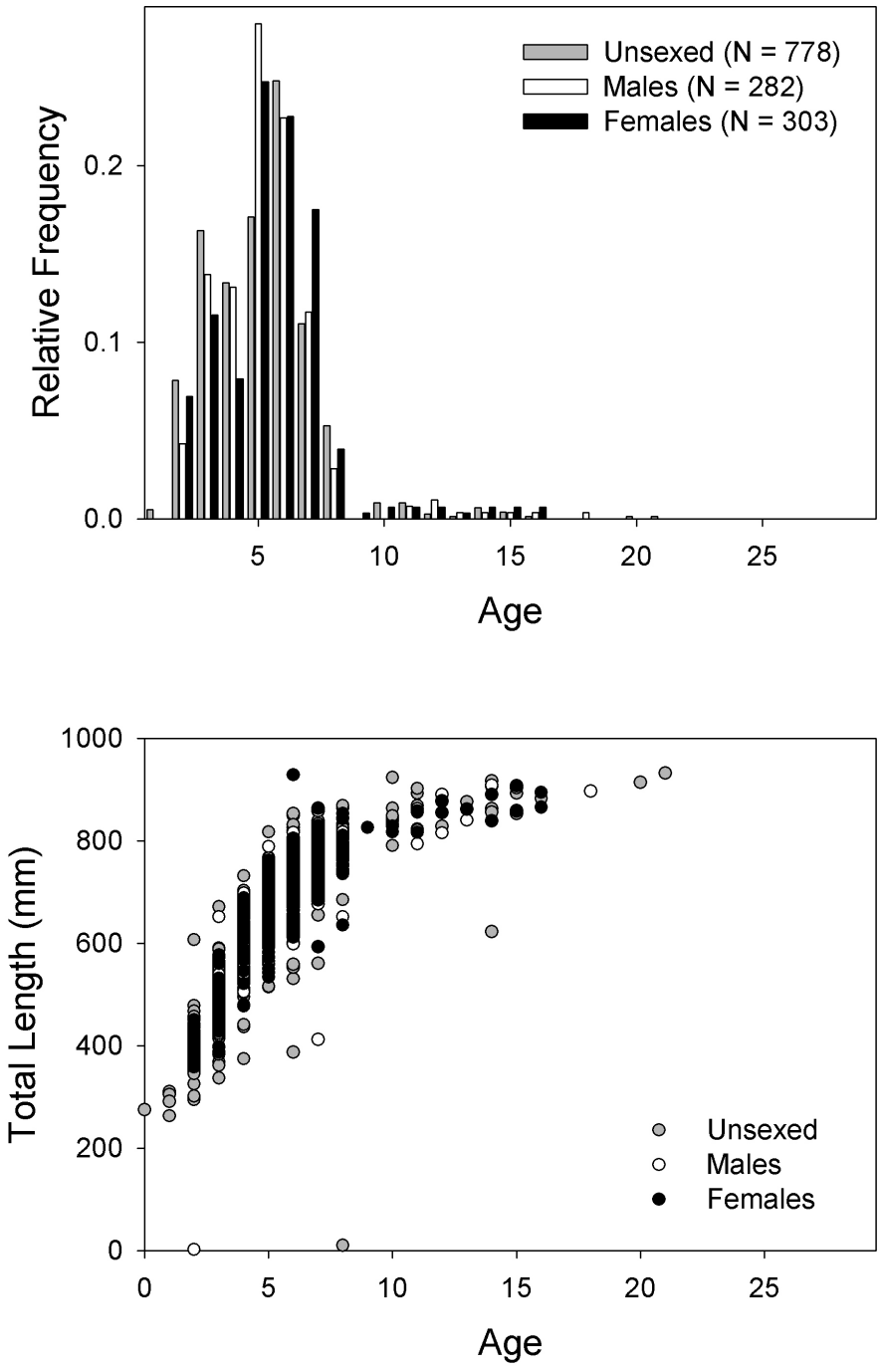

Figure 11. Summaries of age-frequency distributions (upper panel) and size at age (lower panel) by sex for red snapper collected in association with fishery-dependent surveys of the private recreational fishery conducted in 2012 and 2013. Note that these plots include samples obtained through random intercept surveys, targeted biological sampling, and volunteer angler carcass donations.

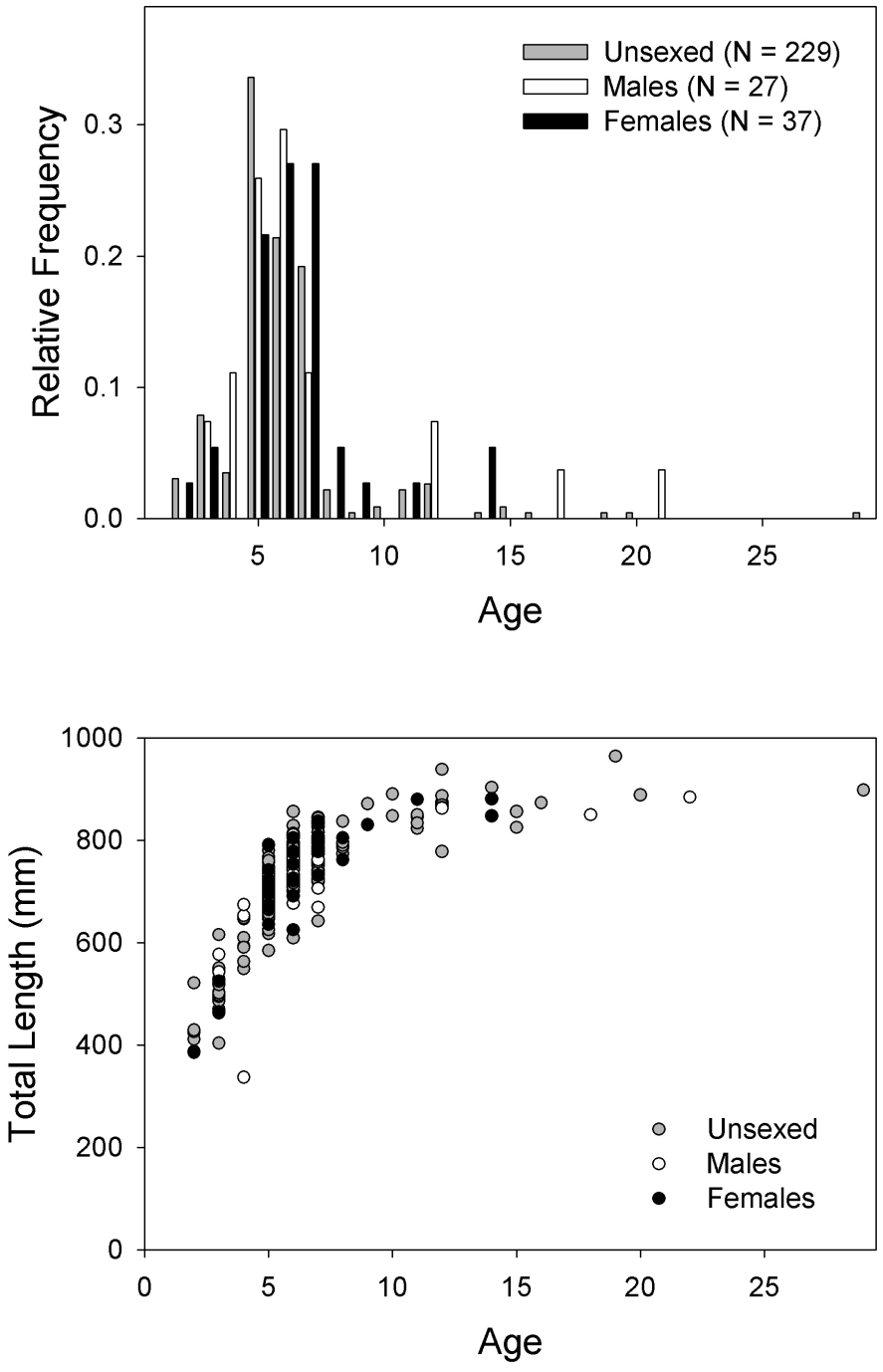

Figure 12. Summaries of age-frequency distributions (upper panel) and size at age (lower panel) by sex for red snapper collected in association with fishery-dependent surveys of fishing tournaments conducted in 2012 and 2013.