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Regional and Fishery-specific Patterns of Age and Growth of Yellowtail Snapper, *Ocyurus chrysurus*

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We sampled yellowtail snapper, *Ocyurus chrysurus*, from commercial and recreational fisheries and fishery-independent surveys in the Atlantic Ocean off south Florida from 1980 through 2002. Specimens were collected primarily from two areas: Palm Beach and Monroe counties; collections were divided at 26° latitude into northern and southern populations. We collected sagittal otoliths and corresponding morphometric data from each population. Fork lengths (FL) ranged from 115 to 605 mm with a mean length of 312 mm. Yellowtail snapper were aged using sagittal otoliths with a high degree of precision [average percent error (APE) <1%]. Ages ranged from 1 to 17 years, with mean ages of 3.96 years for the commercial fishery, 3.33 years for the recreational fishery, and 3.00 years for fishery-independent surveys. Yellowtail snapper entered the commercial and recreational fisheries by age 2; both fisheries were dominated by 2 and 3 year olds. The commercial fishery indicated the influence of a strong 1994 year class; this was not apparent in the recreational and fishery-independent surveys possibly due to small sample size. The von Bertalanffy growth curve parameters for all years and fishing modes combined [$L_t = 410(1 - e^{-0.27(t+2.03)})$] were similar to previously published estimates for yellowtail snapper. The instantaneous total mortality rate of yellowtail snapper for all years and fishing modes combined (Z = 0.49) was also similar to previously published estimates. The total mortality rate for the northern population, Z = 0.67, was greater than for the southern population, Z = 0.45. Weight–length relationships were significantly different between northern and southern populations ($P < 0.001$), and yellowtail snapper from the southern population were significantly larger and older than those from the northern population ($P < 0.001$). Size-at-age was significantly larger for the most common ages (1–4 years) in the northern population compared to the southern population (age 1, $P = 0.002$; age 2–4, $P < 0.001$). This may be due in part to differential fishing pressure; additional site-specific sampling is needed to elucidate the demographic differences between populations.

INTRODUCTION

Yellowtail snapper, *Ocyurus chrysurus,* are found in tropical and subtropical waters of the western Atlantic Ocean from North Carolina to Brazil and are most common in the Bahamas, Caribbean, and southern Florida (Manooch and Drennon, 1987). Yellowtail snapper juveniles are often found nearshore in turtle grass, *Thalassia testudinum* (Bortone and Williams, 1986). Adults are associated with coral reefs and other hard-bottom substrate and are generally more pelagic than other snapper (Hoese and Moore, 1977; Manooch and Drennon, 1987). Results of tagging studies indicate that movement of adults over large distances is limited (Beaumariage, 1969).

Yellowtail snapper are a popular sport fish that has been exploited for more than 100 years off southern Florida (Muller et al., 2003) and supports important commercial and recreational fisheries (McClellan and Cummings, 1998). Commercial landings off the Florida Atlantic coast peaked in 1993 at 84.3 metric tons. Landings had declined to 54 metric tons by 2001 [National Marine Fisheries Service (NMFS), 2004].

Age and growth of yellowtail snapper has been examined in the Caribbean (Piedra, 1969; Claro, 1983; Manooch and Drennon, 1987) and off the southeastern United States (Johnson, 1983; Garcia et al., 2003). Recent studies have shown that sagittal otolith sections are the most reliable method of age determination for yellowtail snapper and have validated annulus formation in sectioned sagittae using marginal increment analysis (Johnson, 1983; Manooch and Drennon, 1987; Garcia et al., 2003).

Our study goals were to provide updated size and age information for stock assessment and to expand life-history information for yellowtail snapper. Our study objectives were to summarize the size and age distribution of fish from the commercial and recreational fisheries

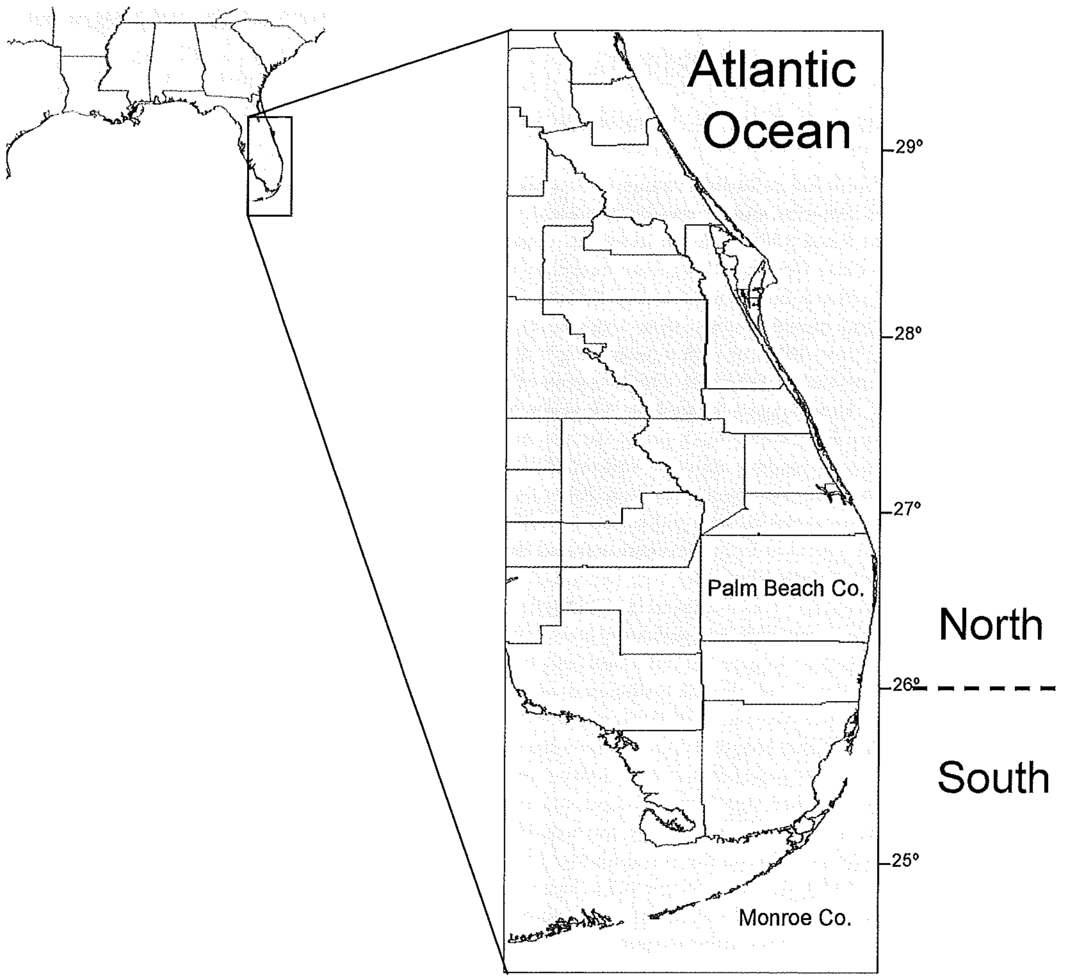

Fig. 1. Yellowtail snapper sampling areas in the Atlantic off southern Florida, divided into northern and southern sampling areas (dashed line). Gray lines are county boundaries.

and fishery-independent surveys off southern Florida and to compare sizes, ages, and growth rates between two areas with differing levels of fishing pressure.

Materials and Methods

Collection.—Yellowtail snapper otoliths and their corresponding morphometric data were collected from Atlantic Ocean landings from 1980 through 2002. Samples were collected from the east coast of Florida. Most collections were concentrated in two areas off southern Florida: Palm Beach and Monroe counties (Florida Keys). Collections were split at the 26° latitude line to compare northern and southern populations (Fig. 1). Samples were collected from commercial boats (1980–81, 1992–2002), charter boats (1993, 1997–2001), headboats (1980–1996, 1999–2002), private recreational boats (1993–94, 1996–99, 2001), and fishery-independent surveys (1998–2002). Charter boats, headboats, and private recreational boats were classified together as recreational. Sampling was conducted by the Trip Interview Program (NMFS), Beaufort headboat survey (NMFS), the Marine Recreational Fisheries Statistical Survey (NMFS), and the Florida Fish and Wildlife Research Institute (FWRI). Most yellowtail snapper sampled were caught with hook and line. In addition, some fishery-independent collections were made with both chevron fish traps (described in Collins, 1990) and 183-m (meter) bag seine, and fishery-dependent samples were taken with band-powered spear guns. Specimens were sampled opportunistically without regard to size or sex. Total length (TL), fork length

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(FL), or both were measured to the nearest millimeter (mm), and if possible a whole weight was recorded to the nearest gram (g). Sex was recorded if the fish was landed whole. In most instances, both sagittal otoliths were removed, cleaned with solutions of bleach and then ethanol, and stored dry. To examine the utility of using otolith weight to estimate age, a subsample of otoliths was weighed to the nearest 0.001 g before sectioning for comparison to age and FL.

Otolith processing and aging.—Otoliths were processed with either a Hilquist high-speed thin-sectioning machine at the NMFS Laboratory in Panama City, Florida, following the methods of Cowan et al. (1995) or a low-speed Isomet saw at the FWRI laboratory. All otolith sections were cut to approximately 0.5-mm thickness and mounted on glass slides with mounting medium. Older archived otolith sections were ground and polished to improve readability. Personnel from FWRI and NMFS laboratories aged otoliths. Sectioned otoliths were assigned an age based on the count of annuli (opaque zones observed with reflected light) along the dorsal edge of the sulcus acousticus and on the degree of marginal edge completion. For example, otoliths were advanced one year in age after 1 Jan. if their edge-type was a nearly complete translucent zone. Typically, marine fishes off the southeastern United States complete annulus formation (opaque zone) by late spring to early summer (Johnson, 1983; Patterson et al., 2001; Wilson and Nieland, 2001; Garcia et al., 2003). Therefore, an otolith with two completed annuli and a large translucent zone would be classified as age 3 if the fish was caught during spring in expectation that a third (opaque) annulus would have soon formed. After 30 June when opaque zone formation is typically complete, all fish were assigned an age equal to the annulus count by convention. Thus, an annual age cohort was based on a calendar year rather than time since spawning (Jearld, 1983). To determine whether aging methods between laboratories were consistent, a reference set of 200 otoliths (100 otoliths prepared by each laboratory) was read by both laboratories, and the ages were compared with average percent error (APE; Beamish and Fournier, 1981). Biological age was used to calculate growth curves. To estimate biological age, a fractional year was calculated as the difference between the peak spawning date and the capture date. We selected 15 June as the peak spawning date based on yellowtail snapper gonadosomatic indices (L. A. Collins, pers. comm.). This fractional period was then added to annual age if the capture date was after peak spawning date or subtracted if capture date was before peak spawning date.

Morphometrics.—Body–size relationships between lengths and weights were characterized with linear and nonlinear regression. Because previous studies have reported yellowtail snapper length as FL, TL was converted to FL to facilitate comparison to other studies. We used the following equation to estimate FL from TL:

$$FL = a + b\ (TL).$$

A power equation was used to express the relationship of weight (g) to FL (mm):

$$W = a\ (FL)^{b}$$

The relationship between otolith weight (OW) and FL was expressed by the equation:

$$FL = a + b\ (OW).$$

The relationship between OW and age (yr) was expressed by:

$$OW = a + b\ (age).$$

To compare length–weight relationships, FL and whole weight were $\log_e$ transformed. After testing for homogeneity of slopes, analysis of covariance (ANCOVA) was used to test for differences between northern and southern populations and between males and females. Least squares linear regression was used to examine the relationship between OW and either FL or age. The analysis of variance (ANOVA) was used to test for differences in FL, age, and size-at-age between populations and between males and females. The assumptions of normality and homogeneity of variance were met prior to analysis (Minitab Inc., 1997).

Growth and mortality.—Growth curves were calculated for all years and fishing modes combined and for males and females with the von Bertalanffy growth function using the solver function in Microsoft Excel 2000 (Haddon, 2001):

$$L_t = L\infty\ (1 - e^{-k(t-t_0)})$$

where L_t = length at time t,

$L\infty$ = asymptotic length
k = Brody growth coefficient
t = age, and
t_0 = theoretical age when length = 0

Growth curves and growth parameters for males and females were tested for differences

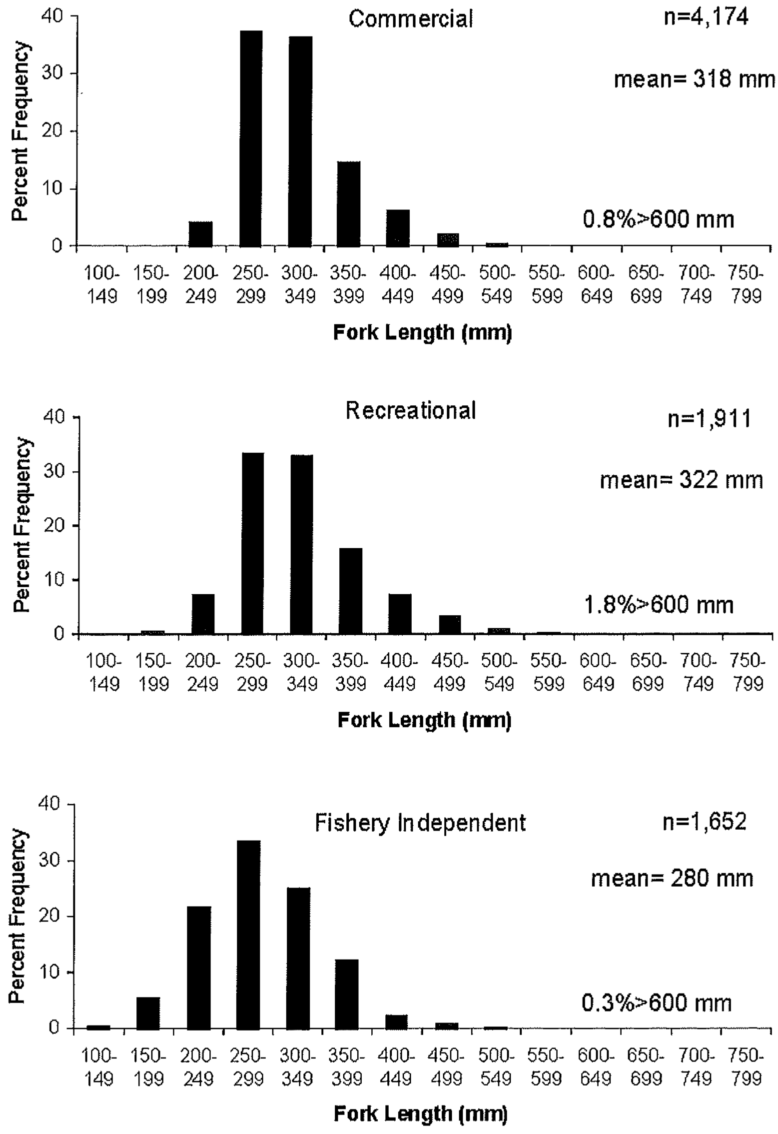

Fig. 2. Length frequency distribution of Atlantic yellowtail snapper by fishing mode.

with a likelihood ratio test (Kimura, 1980). In addition, a growth curve was calculated for all fish combined in which t_0 was restricted to 0. Instantaneous total mortality rates (Z) were calculated with age-based catch curves for all years and fishing modes combined and separately for northern and southern populations (Ricker, 1975). The natural logarithm of fish frequency in each age class, starting with the first fully recruited age through the oldest age, was regressed on age. We only included age frequencies with greater than five observations in the analysis.

Results

Collection.—We sampled 7,737 yellowtail snapper from Florida Atlantic coast landings from 1980 to 2002. Of these yellowtail snapper, the county was recorded for 77% of the fish landed. Two areas accounted for most Atlantic yellowtail snapper with county information sampled: Palm Beach County (48.5%) in the north and Monroe County (44.5%) in the south. More than half of the yellowtail snapper recorded were from commercial catches (54%); recreational catches (headboat, charter boat,

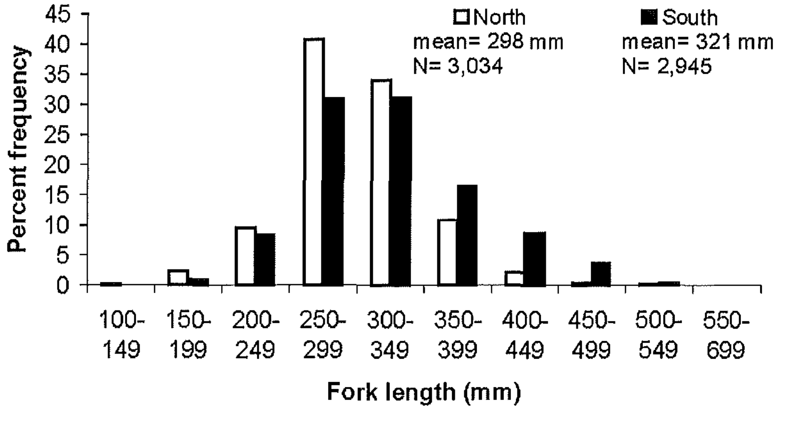

Fig. 3. Length frequency distribution of Atlantic yellowtail snapper by sampling area (all modes combined).

and private boat combined) accounted for 25% and fishery-independent surveys for the remaining 21%. The gear recorded most often was hook and line (95%), followed by chevron trap (4%). Long-line, seine, and spear gun landed less than 1% of yellowtail snapper sampled.

Morphometrics.—Yellowtail snapper ranged in size from 115 to 605 mm FL with a mean of 312 mm FL. Size distributions were similar between sample populations from the recreational and commercial fisheries with a mean size of 322 and 318 mm FL, respectively (Fig. 2). Mean FL of fishery-independent survey fish was on average smaller (280 mm FL) than both the recreationally and commercially caught fish. This was probably due to the absence of the 12-inch (305 mm TL) size limit imposed on the commercial and recreational fisheries and implemented in 1983 by the South Atlantic Fishery Management Council and adopted for Florida waters in 1985. Fish collected from southern sampling sites were significantly larger on average than those collected from northern sampling sites ($F_{1,5,978} = 224.80$; $P < 0.001$); mean FL in the south was 321 mm compared to 298 mm in the north (Fig. 3). No significant difference in FL was noted between males and females ($F_{1,1,595} = 1.53$, $P = 0.22$).

Morphometric relationships for yellowtail snapper are given in Table 1. The relationship between TL (mm) and FL (mm) was estimated from 711 fish for which TL and FL was recorded. A power function showed that weight (g) increased exponentially with FL (mm). A significant positive linear relationship existed between OW and FL, as well as OW and age ($F_{1,1,350} = 2{,}746$, $P < 0.001$; $F_{1,1,153} = 2922$, $P < 0.001$). ANCOVA indicated that yellowtail snapper from the southern sampling area were significantly heavier at FL compared to those from the north ($F_{1,1,753} = 76.19$; $P < 0.001$). No significant differences were found between males and females for length–weight relationships ($F_{1,1374} = 0.09$, $P = 0.76$).

Age determination.—Ages were successfully assigned to 86% (6,679) of all otolith sections. Many otoliths from the past had been cut, mounted, and archived years earlier. Due to the effects of time and less advanced preparation methods, many of these otoliths were deemed unreadable.

Ages from the test set of 200 otoliths indicated high reader precision between the two laboratories. Ninety-five percent of age readings were in agreement; all disagreements were within ± 1 year. Average percent reader error (APE) was low at 0.83% (CV = 1.02%). Ex-

TABLE 1. Morphometric relationships for yellowtail snapper from southern Florida.

Relationship	Equation	Number	R^2
Fork length (TL) mm – Total length (FL) mm	FL = 0.76 (TL) + 18.34	711	0.98
Weight (W) g – Fork length (FL) mm	$W = 2.0 \times 10^{-8} (FL)^{2.93}$	1,754	0.95
Fork length (FL) mm – Otolith weight (OW) g	FL = 1297.2 (OW) + 179	1,349	0.78
Otolith weight (OW) g – Age	OW = .014 (Age) + 0.048	1,183	0.71

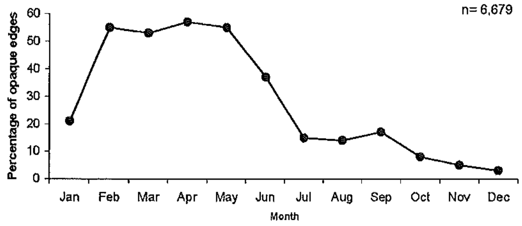

Fig. 4. Percent of otoliths with opaque edges for all aged yellowtail snapper.

amination of otolith edge type suggested that opaque increments are formed once annually during the late winter and spring (Fig. 4). More than 50% of otoliths collected during Feb.–May had opaque margins with the highest proportion of opaque margins (57%) found in April.

Yellowtail snapper ranged in age from 1 to 17 years (Fig. 5). The mean age of fish landed by the commercial fishery was 3.96 years (Fig. 5A). An age frequency distribution indicated that yellowtail snapper enter the commercial fishery by age 2. Fifty-three percent of commercial landings were comprised of 2 and 3 year olds, whereas only 3.2% of individuals were 10 years or older. The mean age of yellowtail snapper from the recreational fishery was 3.33 years (Fig. 5B). Yellowtail snapper also recruited to the recreational fishery by age 2, and the fishery consisted largely of 2 and 3 year olds (66%); less than 1% of individuals were 10 years or older. The mean age of fishery-independent survey fish was 3 years with more than half (53%) of individuals 2 and 3 years old (Fig. 5C). However, due to the absence of size limits, fishery-independent surveys collected more 1-year-old individuals (18.2%) compared to the commercial and recreational fisheries (2.4% and 2.7%, respectively). Fish collected from southern sampling sites ranged from 1 to 17 years and were significantly older on average than those collected from the northern sites, which ranged from 1

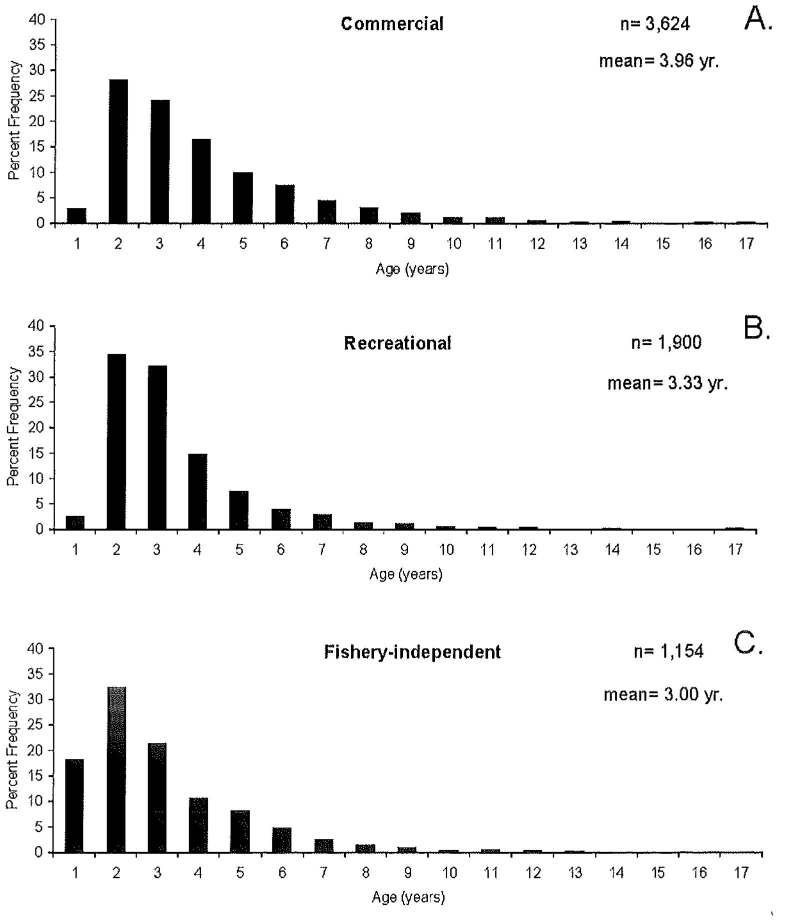

Fig. 5. Age frequency distribution of Atlantic yellowtail snapper by fishing mode.

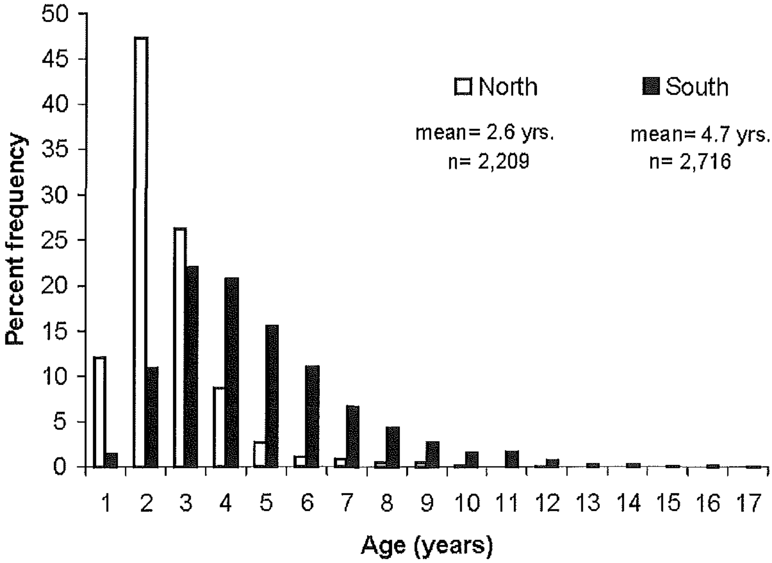

Fig. 6. Age frequency distribution of Atlantic yellowtail snapper by sampling area.

to 12 years ($F_{1, 4,924}$ = 7944; $P < 0.001$; mean age south = 4.7 yr; mean age north = 2.6 yr) (Fig. 6). Age distributions were significantly different between males and females ($F_{1, 4,077}$ = 13.12, $P < 0.001$).

An examination of the age frequency distribution by year for the commercial fishery indicated the influence of a strong 1994 year class starting in 1996 with large numbers of 2 year olds, followed by 3 year olds in 1997 and by 4 year olds in 1998 (Fig. 7). The last three recorded years for the commercial fishery (1999, 2000, and 2001) indicated a shift to younger ages with a mode at age 2. The recreational fishery was highly selective for 2 year olds most years, with several years consisting of 40% or more at age 2. There was also evidence of possible influence of strong 1979 and 1992 year classes in the recreational fishery. However, this evidence is tenuous given that many years had few recreational samples. Age-2 fish also dominated the fishery-independent surveys most years.

Growth and mortality.—A plot of FL by age indicated large variation in size-at-age (Fig. 8). Size-at-age was significantly larger for ages 1–4 from the northern population compared to the southern population (age 1, $F_{1,303}$ = 9.92, P = 0.002; age 2, $F_{1, 1,303}$ = 123, $P < 0.001$; age 3, $F_{1, 1,161}$ = 125, $P < 0.001$; age 4, $F_{1,738}$ = 39, $P < 0.001$; Table 2). A comparison of size-at-age by sex showed a significant difference for age-1 fish ($F_{1,279}$ = 13, $P < 0.001$), but did not show any significant differences for ages 2 ($F_{1, 1,153}$ = 0.34, P = 0.56), 3 ($F_{1,899}$ = 0.02, P = 0.90), or 4 ($F_{1,591}$ = 0.81, P = 0.37). In comparing our results to previous studies (Table 3), a von Bertalanffy growth equation was fitted to FL and biological ages for all years and fishing modes combined. No significant difference was noted between growth parameters for males and females. The asymptotic length (L_∞) was estimated at 410 mm FL with a growth coefficient (k) of 0.27 and size at time zero (t_0) of −2.03. When t_0 was force through 0, L_∞ was estimated at 365 mm and k at 0.65.

The instantaneous mortality rate (Z) for all years, areas, and fishing modes combined was 0.49 (ages 3–14). The mortality rate for the northern population (Z = 0.67; ages 3–9) was higher than for the southern population (Z = 0.45; ages 4–14).

Discussion

Yellowtail snapper is a moderately long-lived species attaining a maximum age of 17 years. This was also reported by Manooch and Drennon (1987), and older than that reported by Johnson (1983; 14 yr), and Garcia et al. (2003; 13 yr). In our samples, size and age distributions from recreational and commercial harvests were similar. Garcia et al. (2003) found similar results between commercial and headboat harvests. This is probably partially due to a common 12-inch TL (305 mm TL) size limit. Fishery-independent survey fish, not constrained by a size limit, were smaller and had a higher percentage of 1-year-old fish than fish-

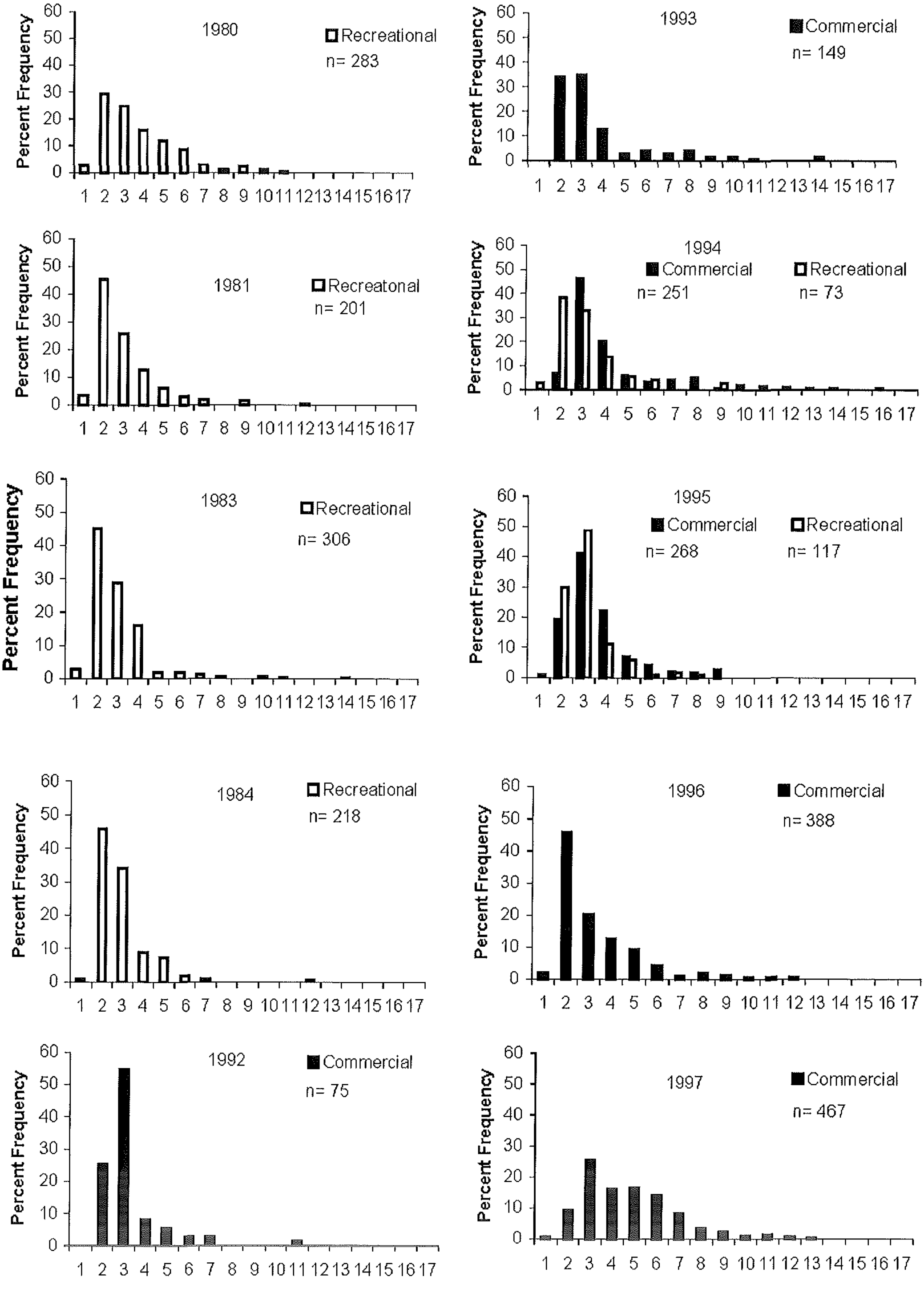

Fig. 7. Age frequency distribution of Atlantic yellowtail snapper by fishing mode and year.

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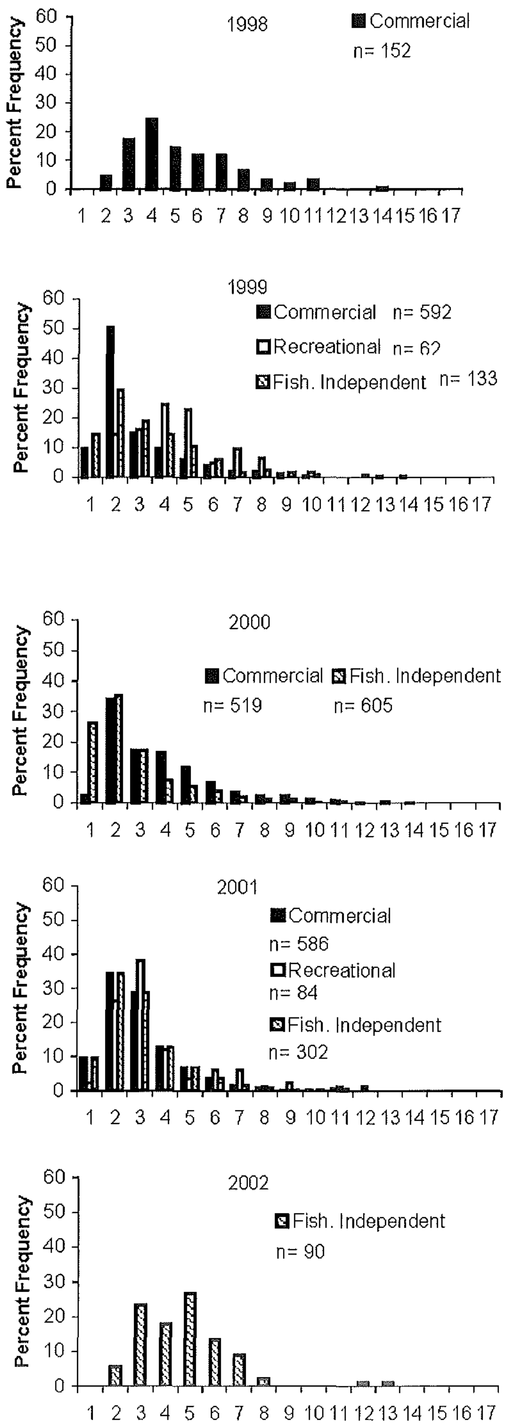

Fig. 7. Continued.

ery-dependent fish (18.2% versus 2.6%, respectively). This was consistent with the findings of Johnson (1983) who aged fishery-dependent fish collected before the size limit was imposed and found a higher proportion (9.5%) of 1 year olds. Our fishery-dependent age frequencies were comparable to those found by Garcia et al. (2003) from fish collected from the mid to late 1990s in which most individuals were 4 years old or less. Fishery-dependent survey ages indicated that most yellowtail snapper do not reach the 12-inch TL (305 mm TL) size limit until at least age 2.

Examination of the percentage of opaque margins suggested that yellowtail snapper deposited opaque zones once annually in the late winter and spring (Feb.–May). This is consistent with the results of marginal increment analysis conducted by Manooch and Drennon (1987) and Garcia et al. (2003). However, Johnson (1983) found that opaque zones were completed later in the year (May–July). We cannot discount that the exact timing of opaque-zone formation may vary geographically or from year to year. However, the most recent studies (ours and Garcia et al., 2003) suggest that the general timing of formation (spring to early summer) is broadly consistent and is a valid basis for assigning a fish to a year class (Fowler, 1995).

Average percent reader error (APE) between the two laboratories was low for yellowtail snapper (<1%). Production-aging laboratories generally consider an APE ≤5% as a target for moderately long-lived species with relatively difficult-to-read otoliths (Morison et al., 1998; Campana, 2001). Yellowtail snapper were aged with higher precision than reported for other lutjanids including red snapper (APE = 5.2%, Allman et al., 2001; APE = 1.25%, Patterson et al., 2001; APE = 3.74%, Wilson and Nieland, 2001) and vermilion snapper (APE = 8.4%, Allman et al., 2001). This gives us increased confidence and leads to the expectation that year-class trends, due to possible recruitment variation, should be apparent when viewed over several years.

The relationship between OW and age was significant, with the coefficient of determination explaining 71% of the variation in age. This is somewhat lower than found in other studies in which otolith weight explained 80–95% of the variation in age (Worthington et al., 1995; Pino et al., 2004). Therefore, the utility of otolith weight as a predictor of age may be of limited value for yellowtail snapper.

Yellowtail snapper from the commercial fishery indicated a dominant 1994 year class relative to other year classes, which was detectable across a three-year time series. Because of the high level of precision with which yellowtail snapper were aged, we feel the age data reveals

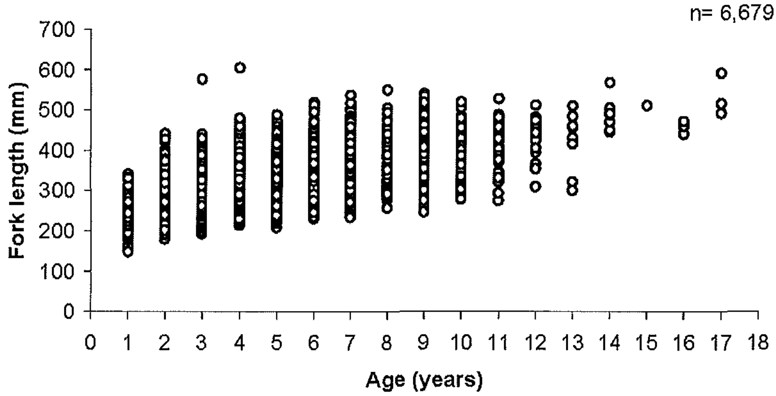

Fig. 8. Yellowtail snapper fork length by age all years and modes combined.

this pattern with a high degree of certainty. However, since it appears that recruitment to the fishery by age 2 is relatively constant across the years, this apparently dominant 1994 year class could merely be a reflection of lower recruitment levels during adjacent years. This is in contrast to the pattern seen in gag (*Mycteroperca microlepis*), which exhibit highly variable recruitment that is clearly reflected in the age-class structure over time (Fitzhugh et al., 2003). The recreational fishery was more selective for 2 year olds than either the commercial fishery or fishery-independent surveys. This could be because recreational anglers generally fish areas closer to shore and probably target slightly younger fish. The recreational fishery suggested evidence of strong year classes in 1979 and 1992. However, due to the relatively small recreational sample sizes for some years, the pattern was not clear.

Large variation existed in size-at-age for most age classes. For example, 4-year-old yellowtail snapper ranged from 220 to 605 mm FL. Large variation in yellowtail snapper size-at-age was also noted by Johnson (1983) and Garcia et al. (2003). Consequently, length is probably not a good predictor of age. The yellowtail snapper growth curve for all years and areas combined was similar to the back-calculated growth curve generated for previous yellowtail snapper studies (Fig. 9). However, asymptotic length from our study was slightly smaller compared to lengths from Johnson (1983) and Garcia et al. (2003). Our growth coefficient (k) was similar to that given by Johnson (1983) and higher than that of Manooch and Drennon (1987)

TABLE 2. Mean fork length (mm) at age (years) of yellowtail snapper by sampling area.

	North				South			
Age (years)	*n*	Mean FL	SD	Range	*n*	Mean FL	SD	Range
1	266	230	34	148–341	39	212	34	152–282
2	1045	281	28	180–392	296	259	34	185–427
3	580	315	33	209–402	599	292	39	199–430
4	191	339	43	228–470	564	317	46	220–605
5	60	338	51	260–488	421	329	49	209–459
6	24	359	52	289–470	299	344	50	231–469
7	17	337	54	247–441	181	363	54	234–485
8	11	312	44	257–410	118	377	59	281–505
9	11	404	92	264–540	74	394	61	263–503
10	3	379	39	340–417	40	402	63	279–506
11					44	410	57	275–528
12	1	425			20	431	56	290–512
13					8	423	75	301–510
14					8	477	22	445–505
15					1	511		
16					3	457	16	440–472
17					1	492		

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TABLE 3. Von Bertalanffy growth equation parameters for yellowtail snapper from the current and previous studies.

Study and location	Maximum age (yrs)	L_∞ mm (FL)	K	t_0
Current study - S. Florida	17	410	0.27	−2.03
Current study with $t_0 = 0$	17	365	0.65	0
Garcia et al. (2003) - S. Florida	13	484	0.17	−1.87
Manooch and Drennon (1987) - Caribbean	17	503	0.14	−0.96
Johnson (1983) - S. Florida	14	451	0.28	−0.36

and Garcia et al. (2003). Some of these differences could have been due to differences in the method for calculating fractional age (i.e., aging equation versus back-calculation). Our overall total mortality rate was lower (Z = 0.49; ages 3–14) than that reported by Garcia et al. (2003) (Z = 0.64; ages 3–13); however, our estimate was very similar to that reported by Johnson (1983; Z = 0.50; ages 2–14). The total mortality rate in the north (Z = 0.67) was considerably higher than that in the south (Z = 0.45), suggesting differential fishing pressure.

Size and age differences existed between yellowtail snapper from the northern and southern sampling locations. Specimens from the south were heavier at length, were on average significantly longer and older, and attained a greater maximum size and age than those from the north. Mean size-at-age was larger in the northern sampling area for the most common age classes indicating faster growth compared to the south.

Limited evidence suggests that fishing effort per unit area is greater in the northern sampling area than in the southern sampling area. The narrow continental shelf and close proximity of the reef tract in the northern sampling area may have allowed for higher fishing mortality per unit area (Muller et al., 2003). This increased fishing pressure could have led to the truncated size and age distributions in the north. Burton (2001) suggested a similar size truncation was occurring in areas where gray snapper were heavily fished compared to less-fished areas. However, Burton's (2001) study found that growth rates were higher in lower fishing pressure areas (northern Florida) compared to the more heavily fished areas (southern Florida). Reduction in size-at-age has been attributed to increased fishing pressure in several other reef fish species (Buxton, 1993; Harris and McGovern, 1997; Zhao et al., 1997). This was not the case for yellowtail snapper, which experienced a higher growth rate in the more heavily fished per area northern sampling sites. These differences between northern and southern sampling areas could not be attributed to size selectivity due to a gear effect (i.e., one fishing mode predominating in one of the areas), since both sampling areas had similar sample breakdowns by fishing mode. In addition, the same growth-rate pattern was ev-

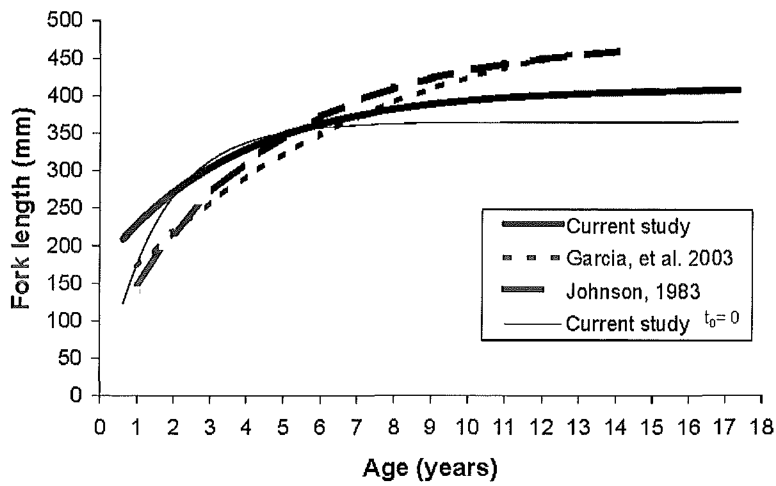

Fig. 9. Von Bertalanffy growth curves for current and other studies.

ident when only the commercially harvested fish were compared between north and south.

Environmental influences (e.g., water temperature, habitat type or quality) also could have played a role in the observed differences between yellowtail snapper in the northern and southern sampling sites. The northern population may merely be a spillover population from a main spawning population in the south since the northern sampling area is near the northern extreme of yellowtail snapper abundance (McClellan and Cummings, 1998). Therefore, the northern population may contribute little to the stock and may not be self-sustaining.

Atlantic yellowtail snapper are managed by the South Atlantic Fishery Management Council as a single stock. Preliminary evidence from yellowtail snapper mtDNA collected off Florida supports this policy (Hoffman et al., 2003). A recent stock assessment determined that yellowtail snapper are currently neither overfished nor undergoing overfishing (Muller et al., 2003). The annual year-class structure indicates that recruitment to the fishery is relatively constant. This pattern of recruitment could act as a buffer to overfishing in yellowtail snapper. However, the differences in size and age distribution and growth rates of yellowtail snapper between sampling areas suggest that differences in fishing pressure could be a factor. Additional site-specific sampling of yellowtail snapper is needed to investigate these demographic differences and to determine the influence of annual variations in recruitment.

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