Information on the general biology of silk and Queen snapper in the Caribbean

by

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Introduction

Commercial fishing has been occurring off Puerto Rico since the late 1800's (Jarvis 1932). Kawaguchi (1974), Nelson and Carptener (1968), Brownell and Rainey (1971), and Sylvester and Dammann (1974) previously noted the importance of silk snapper in the Caribbean reef fish fisheries as early as the 1970's. Sylvester et al. (1980) and Tabash and Sierra (1996) emphasized the importance of documenting the species biology in order to determine adequate management strategies. In response to a request for information in 2003 on deep water snapper fisheries of Puerto Rico and the U.S. Virgin Islands by the Caribbean Fishery Management Council, biological information on silk and queen snapper was reviewed. The silk and queen snapper, members of the Lutjanide are one of the largest teleostan families, which includes 4 sub families, 17 genera, and 103 species (Allen 1985, Chow et al. 1993). This report presents a summary of the scientific literature on the general biology of silk, *Lutjanus vivanus* (Cuvier 1828) and queen (*Etelis oculatus)* (Valenciennes 1828) snappers, two species that are commonly observed in the commercial deep water reef fish fisheries of the Virgin Islands and Puerto Rico. Herein is provided summary information on their distribution, stock structure, growth, and reproduction.

Methods

Published and non-published publications were reviewed to obtain biological information for silk and queen snapper. In addition electronic computer databases of summary biological reference material was accessed including Fishbase (ICLARM 2000).

Summary Biological Information

Silk Snapper (Lutjanus vivanus)

Distribution, Habitat, Association with other species, and Stock Structure

The silk snapper is a commonly caught lutjanid in the Western Atlantic, occurring as far north as North Carolina, including off Bermuda, the Gulf of Mexico to northern South America as far south as Trinidad and northern Brazil (Bohlke and Chaplin 1968, Struhsaker 1969, and Allen 1985). The species, common near the edge of the continental and island shelves, inhabits waters mainly between 90 and 140 m although it has been observed up to about 300 m (Carpenter 1965, Rivas 1970, Sylvester and Dammann 1973, Allen 1985). Off the Carolinas and the Florida Keys the species mainly occurs between 25 and 72 m (Bullis and Thompson 1965) while in the Gulf of Mexico it has been found at depths between 162 and 216 m. Rivas (1970) reported on silk snapper which were sampled using bottom gear at depths from 30 m to 360 m, from 1950 through 1968 between Cape Hatteras, North Carolina and Fortaleza, Brazil by the Bureau of Commercial Fisheries (Exploratory Fishing and Gear Research Base, Pascagoula, Mississippi) in conjunction with the U.S. Fish and Wildlife service. Sylvester and Dammann (1973) found silk snapper at depths from 81 to 378 m Sylvester et al. (1980) noted the possibility of different habitats for silk snapper adults and juveniles as supported by the fishery in Puerto Rico. Using electric reels in the early 1970's, Sylvester and Dammann reported that silk snapper were caught over irregular substrates with adults found mainly over mud bottom. According to Rivas (1970) silk snapper are the only deep water snappers found over mud substrate in the Western Atlantic in particular the region referred to as 'lower-shelf habitat' by Struhsaker (1969). The studies of Brownell and Rainey (1971), Sylvester

(1974), Boardman and Weiler (1979) suggest that silk snapper are commonly associated with blackfin and voraz snapper as well as several other species of groupers and jacks. Sylvester and Dammann (1974) observed silk snapper from 80 to 350 m (average 200 m) while blackfin were more common from 48 m to 82m. Boardman and Weiler also observed silk snapper associated with vermilion snapper (off Puerto Rico). These studies also suggested that silk were more frequent at the greater depths up to 175 m while blackfin and vermillion at the shallower depths (<100 m) (Boardman and Weiler 1979). Sylvester's studies were conducted off the U.S. Virgin Islands or nearby off Anegada and/or Virgin Gorda. Rivas (1970) suggested that bottom type could be an important factor in determining the actual vertical depth distribution of snappers. It is especially interesting to note that the tendency to school by size was observed in some of the studies (Dammann et al. 1970). In 111 bottom long sets made by the National Marine Fisheries Service (NMFS) from 76 m to 644 m, off St. Thomas and Puerto Rico (including Culebra Island) in August 1982 (Russell 1982) silk snapper were observed occurring from 200 m to 322 m somewhat shallower than were queen snapper which were captured from 206 m to 484 m. In 90 bottom longline sets made in April 1984 (Russell 1984) by the NMFS off Puerto Rico, Culebra and St. Thomas silk snapper were captured most frequently between 200m and 298 m. Similar surveys were conducted during 1980 and 1983 by the NMFS and those results could provide additional knowledge regarding the distribution of this species.

Morphometrics

Silk snapper is characterized by a normal fusiform body shape, weak preopercular notch and knob and long pectoral fins that reach the level of the anus. Individuals have pink to red coloration on the back and upper sides often appearing as a silvery sheen along the lower abdominal region. The fins of individuals are usually reddish or pale yellow. Small or young individuals (<25 cm) individuals usually have a blackish spot on the upper side below the anterior dorsal soft rays. Maximum size observed in the field was 83 cm (total length) and 8.3 kg (IGFA 2001, Allen 1985). Chow et al. (1993) noted the close similarity morphologically among members of the Lutjanidae family, reported by previous ichthyologists (Richards 1985, Leis 1987, Richards and Lindeman 1987) making it especially difficult to differentiate between identification of larvae. Using restriction fragment length polymorphism (RFLP) analysis, silk snapper could be identified (Chow et al. 1993).

Food Habits

The silk snapper are considered mainly carnivorous by most researchers as are most members of the Lutjanidae. Randall (1968) noted that the larger species of the Lutjanidae eat mostly fishes. The stomachs of silk snapper sampled off the U.S. Virgin Islands in the early 1970's included fish (51%), isopods (8%), invertebrates (31%). The species is reported to ascend to shallower waters at night for feeding (Bohlke and Chaplin 1993). Parrish noted that most snappers tend to feed more actively at night. Allen (1985) reported silk snapper also feeding occassionally on some pelagic items such as urochordates.

Reproduction

The species is dioecious with no known tendency to change sex, and fertilization is external (Allen 1985). Spawning is thought to be year round in the more tropical latitudes with two

predominant peaks. Silk snapper are thought to spawn in late spring through early summer in the temperate regions (e.g., Carolinas, Gulf of Mexico). Munro et al. (1973) reported on spawning of silk snapper from observations made off the reefs adjacent to Port Royal, on the south coast of Jamaica and on Pedro Bank and on Morant Bank, 50 NM southwest and southeast of Jamaica. Silk snapper were observed in ripe condition during March, September and November, suggesting year round spawning. Munro et al. (1973) also suggested two maxima in spawning timing, in April and September-October, for silk snapper off Jamaica. Leis (1987) reported on the early life history of tropical snappers from a review of the literature. Leis noted that based on the available information from larval abundance that most lutjanids spawn year-round and with an apparent maximum reproductive activity in the spring and summer. Grimes's (1987) reviewed Lutjanidae reproduction and he put forth the idea that the seasonality pattern in spawning (i.e., a restricted spawning period during late spring/summer vs spawning year round) was related to geographical location with populations occurring on oceanic islands being characterized by year-round spawning while those occurring along the continental areas had more restrictive spawning periods. Grimes (1987) further noted that some specific populations did not seem to conform to this pattern and gave as examples those off Cuba, new Caledonia, and the deep water *Egelis carbunculus* off Hawaii and provided some reasoning based on continental production volume allied to high rainfall.

Sex Ratio

Boardman and Weiler (1979) reported a sex ratio for males to females of 0.8:1 (1.25:1) for fish sampled by traps off Puerto Rico. Sylvester et al. (1980) observed sampled silk snappers off the US Virgin Islands between July and September 1973 using bottom fishing gear, set lines, and traps. From some 27 sampling trips a sex ratio if 1.16 (male:female) was observed from 141 individual fish. Boardman and Weiler (1979) noted difficulty in identifying males in certain developmental stages which had large deposits of fat in the body cavity. Grimes (1987) reviewed the reproductive biology of the _Lutjanide and commented on sexual dimorphism and hermaphroditism in the Lutjanidae. Analyses of sex ratios in species of this family from geographically diverse locations did not suggest any trend towards variation in sex ratio at size that would indicate hermaphroditism. Grimes (1987) further noted that from the data of the more thorough studies (i.e., those in which a wide range of sizes were observed) suggested a tendency for females to be more prevalent at the larger sizes and suggested a differential longevity of the sexes.

Maturation Timing and Fecundity

Summarized information on silk snapper maturity and fecundity is presented in Table 1. Boardman and Weiler (1979) observed silk snapper off Puerto Rico maturing at abut 38 cm and 50 cm respectively for males and females. Silk snapper off Cuba matured at 48 cm (females) and 50 cm (males) while silk snapper off Jamaica matured at 52 cm (females) and 57 cm (males) similar to fish from Puerto Rico. Grimes (1987)'s review of reproduction in Lutjanidae suggested that for deep reef (>91 m in that review) snappers, individuals matured at about 49% of the maximum length while the shallow-water species matured at about 43% of the maximum length. This would suggest that the silk snapper could mature at about 37 cm somewhat smaller than that observed in the field for fish sampled off the U.S. Virgin Islands, off Cuba, or off Jamaica.

Sylvester (1970) suggested two spawning periods for silk snapper, one from April - June, and another from October-December, based on the presence of two abundance peaks for fish sampled off the U.S. Virgin Islands between July 1970 and December 1972. That study suggested a spawning maxima occurring in March and another around September-October. Collazo (1983 or 1984) from examination of some 2200 fish off Puerto Rico between 1979 and 1980 reported silk snapper spawning year round with two peaks in the percentage of ripe females occurring between April and June and October-December. Sylvester et al. (1980) examined fish off the U.S. Virgin Islands also for fecundity information. They noted the occurrence of a large number of immature eggs in mature ovaries suggesting greater than one spawn per year. The fecundity information shows large individual variation for this species. Sylvester et al. (1980) noted that eggs of silk snapper were smaller and more numerous than those of another snapper inhabiting deep waters, the blackfin snapper, *L. buccanela.*

Very little information exists regarding the duration of the larval period. Leis (1987). The results of three studies (Richards 1982, Starck 1970, and Brothers et al. 1983) suggest empirical estimates ranging from 25 to 47 days for the pelagic phase for shallow water Lutjanids..

Growth

Age Length Relations

Several investigators have evaluated the relation between length and age from length frequency statistics and otoliths for different regions (Table 2). Records from angling reports suggest that the maximum size achieved by this species is about 76 cm and 6 kilograms. Thompson and Munro (1974) reported the maximum observed size in trap catches off Jamaica to be 72 cm FL and 68 cm FL for females and males respectively. From the summarized growth information estimates of the annual growth rate parameter, k, ranged from about 0.1 to 0.32 while estimates of the asymptotic size, L infinity, ranged from 53 cm (FL) to 76 cm (FL) for fish from Cuba, Costa Rica and the U.S. Virgin Islands. Claro and Garcia-Arteaga (2001) noted that the growth rate parameter, k, derived by Thompson and Munro (1983) for silk snapper may be excessively high. Thompson and Munro (1983) reported that otoliths of silk snapper did not reveal regular clear bands easily interpretable as annuli. In general this species is characterized as relatively fast growing and showing some trend for a pattern of linear growth in the early years (Musa et al. 1979). Several studies exist describing other important meristic conversions such as length to length and weight to length formulae (Tables 3 and 4.).

Longevity

Tabash and Sierra's (1996) study off Costa Rica suggested a maximum life span of about seven years for silk snapper. These authors estimated size at first capture for 50% of the population to the hook and line fishery to be 25.5 cm or about 1.9 years of age.

Recruitment timing and size

Sylvester (1974) and Sylvester et al. (1980) studied silk snapper off the U.S. Virgin Islands and reported recruitment to the fisheries began at age 2 and full recruitment occurred by

age 4. Sylvester (1974) observed individuals as small as 10-19 cm occurring during October through December.

Natural Morality

Tabash and Sierra (1996) estimated natural mortality for silk snapper using Ralston's (1987) method to be 0.86.

Queen Snapper (Etelis oculatus)

Very little scientific information exists for this species . A few investigators have reported on the occurrence of the queen snapper in local fisheries. Thompson and Munro (1974) and Mahon et al. (1981) noted the importance in the Jamaican and Barbados fisheries respectively. The queen snapper is known in the St. Lucian fisheries as the 'Red Snapper' and makes up about 98% of the demersal landings between August and November annually from south of the island. Small individuals are apparently taken as by-catch in some trawl fisheries (Cervigón et al. 1992).

Distribution, Habitat, Association with other species, and Stock Structure

This species has a similar distribution as the silk snapper and is found in the Western Atlantic: Bermuda and North Carolina, USA, Gulf of Mexico southward through the Caribbean to Brazil. The queen snapper is reported to be particularly abundant in the Bahamas and the Antilles (Anderson, pers. comm as cited in ICLARM Fishbase) . Queen snapper commonly is found in areas characterized by rocky bottoms and is abundant near oceanic islands. Direct observations of vertical distribution of the queen snapper are available from bottom longline sets made during scientific research cruises in August 1982 and April of 1984 by the NMFS off Puerto Rico , Culebra Island and St. Thomas (Russell 1982, 1984). Queen snapper were observed most frequently at depths of 206 m to 484 m from bottom longline sets made during the 1982 NMFS cruise and at depths of 300 m to 398 m during the 1984 NMFS cruise. Similar cruises were conducted during 1980 and 1983 and those results may add further insight into the vertical distribution of this species.

Morphometrics

The queen snapper has a small head and distinct large eye with a short snout. The body is generally fusiform. The maxilla is covered with small scales, a slight protrusion of the lower jaw. The dorsal and anal fin bases are scaleless and the caudal fin deeply forked with the scale rows on the back running parallel with the lateral line. The coloration in the queen is distinct as in the silk snapper. The back and upper sides are deep pink to red; lower sides and belly pink; fins pink except the spinous portion of the dorsal fin and the entire caudal fin brilliant red (ICLARM Fishbase)

Food Habits

As does other Lutjanidae the queen snapper eats animals and feeds and mostly on small fishes and squids as an adult. Younger queen snapper individuals also take crustraceans.

Reproduction

The queen snapper like the silk snapper exhibits dioecism. Spawning is probably year round (see below), and fertilization is external however detailed information on reproduction in this species is not available.in the literature.

Growth

Growth characteristics of the queen snapper are available from a very restricted geographical area. Maximum size of 100.0 cm TL and maximum published weight of about 5.3 kg has been observed from sport fishing angling records. Relationships for length to length and/or weight to length conversions were described from fish off Saint Lucia (Tables 5 and 6). Little information exist for converting lengths to ages and in particular from the U.S. Virgin Islands and Puerto Rico fish, the area of concern to the CFMC/SEFSC Caribbean Deep Water SEDAR data workshop (Table 7) The initial examinations of fish off Saint Lucia suggest the need for more detailed and comprehensive field collections of queen snapper ageing observations to better evaluate growth in this species. Murray and Neilson (2002) emphasize the need to confirm the estimates of queen snapper growth rate and to further evaluate their method (i.e.., pooling growth increments from several segments) of analysis. Furthermore, Murray and Neilson (2002) noted that an overestimation of the growth rate parameter, k, would not be surprising from their approach. Murray and Neilson's (2002) estimate of k was 0.621

Recruitment timing and size

Murray et al. (1992) suggested this species had two pulses of entrance into the local fisheries based on examination of landings records. Murray et al. suggested that when taking into account the seasonality in reproduction this pattern of recruitment resembled that suggested by Grimes (1977) of "more or less continuous year round spawning with peaks of reproductive activity in the spring and fall." These authors however pointed out that queen snapper were probably available to the Saint Lucian fisheries year round but were fished exclusively only during the fishing when tuna catch rates we low in St. Lucia.

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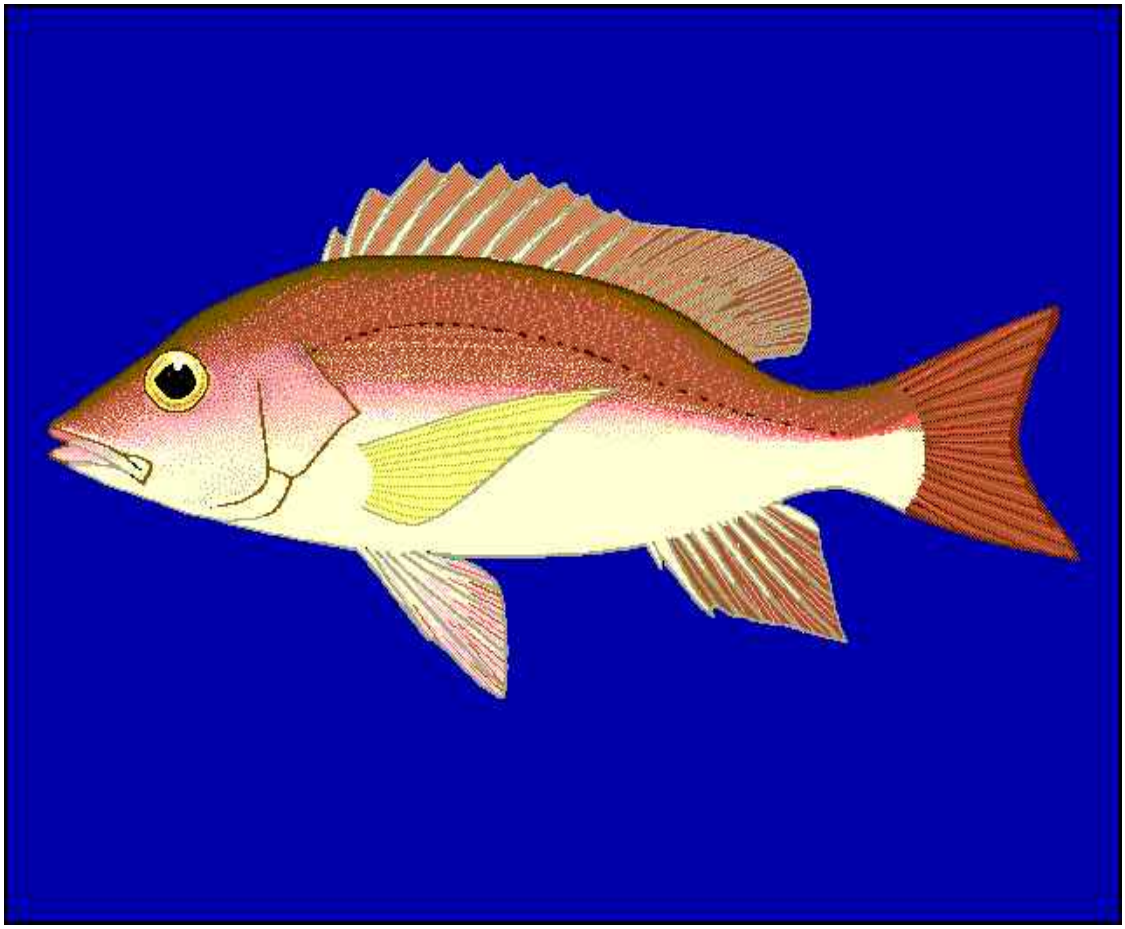

Figure 1. *Lutjanus vivanus*, Silk snapper (Valenciennes, 1828). Taken from FishBase drawing set by Robbie Cada].

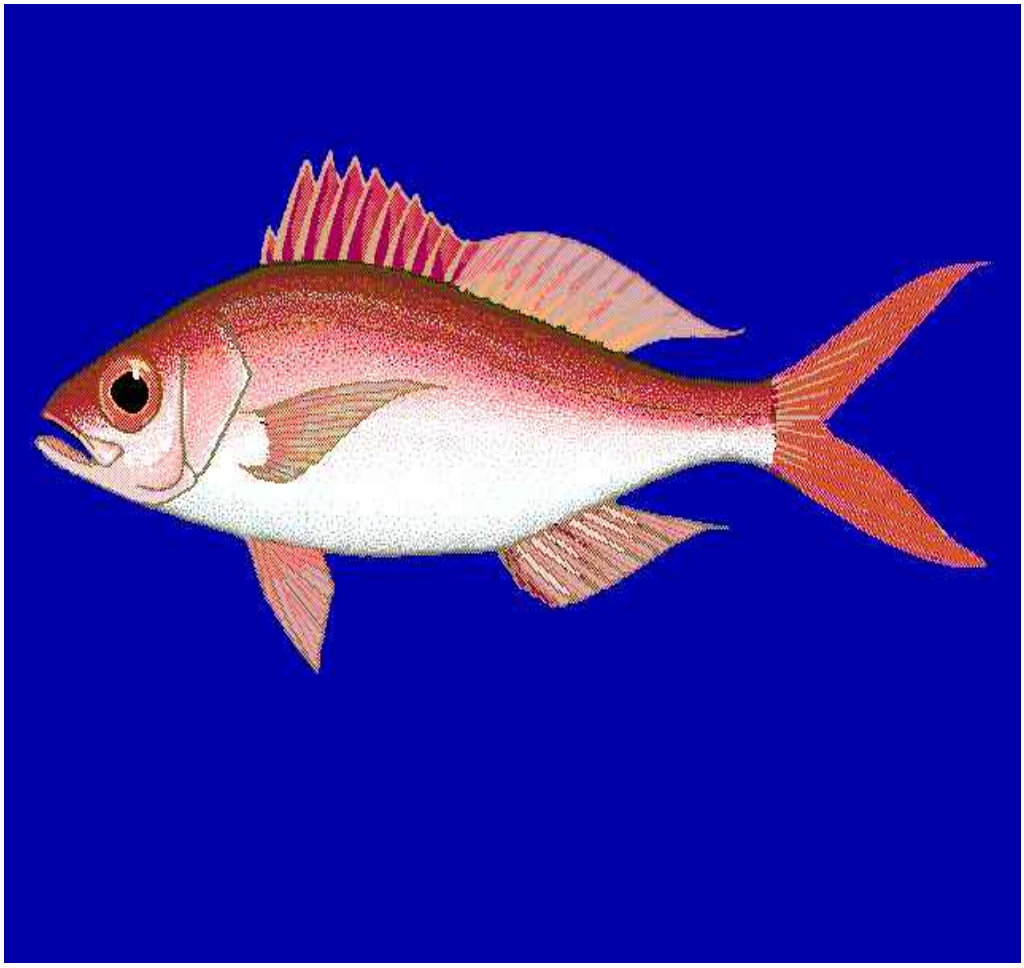

Figure 2. *Etelis oculat*us, Queen snapper, (Valenciennes, 1828). [Taken from FishBase drawing set by Robbie Cada].

Table 1. Summary information on the fecundity of silk snapper from the published literature.

Study	Study area	Study Period	Maturity and Fecundity information	Spawning Period or Season
1. Thompson and Munro (1973)	Jamaica	November 1969 - March 1973	50% maturity 50-55 cm females, 55-60 cm fl males	Spawning year round.
2. Erdman 1976 cited in (2)	Puerto Rico	1976	Spawned year round	
3. Grimes et. al. 1977	North Carolina	1970's	Spawned year round with two peaks (July-September) October-December	
4. Boardman and Weiler 1979	Puerto Rico	1978	50% maturity 50cm females,38 cm males	Spawning year round
5. Sylvester et al. 1980	U.S. Virgin Islands	July 1972 - September 1973	Range in length 25.5 cm to 63.0 cm, n=24 mean # eggs = 108,000 range = 9,000 to 299,000	Not clearly identified in the study Authors suggested fish may spawn throughout the year
6. Collaxo 1983 or 1984	Puerto Rico (San Juan, Mayaguez, Ponce)		n=2201 fish	Spawning observed year round (Table 7 that report) with peaks observed in 2 periods (April-June, October-December).

Comment: Copy of report read an in author's possession however, no year given of publishing.

Table 2. Summary information on length to age relationship for silk snapper from the literature.

	Parameter	Units	Estimate	Reference	Sample Size	Study Area	Sampling Dates	Analysis Method
1.	L infinity	cm	62.0	Tabash and Sierra 1996	1,867	Costa Rica	Sampled 8/1992-11/1994 monthly samples taken	ELEFAN I as implement in FiSAT (Gayanilo et al. 1996)
	k	year	0.32					
	tzero	year	-0.04					
	theta		0.85					
	theta-prime		3.09					
2.	L infinity	cm	70.0	Thompson and Munro (1974)		Jamaica		
3.	L infinity	cm	53.0	Reshetnikov and Claro 1974		Cuba		From otoliths and urohyal bones
	k	year	0.35					
	tzero	year						
	theta		2.99					
	theta-hat							
4.	L infinity	cm	76.0	Garcia 1979		Cubs		Length based
	k	year	0.14					
	tzero	year						
	theta		3.30					
	theta-hat							
5.	Maximum size	cm	115.0	Sylvester et al. 1980.		Virgin Islands	Sampled 7/1972 - 8/1973	Walford Plot

(Tobago Cay and south of Frenchcap Cay)

Table 2. Continued

6.	L infinity	cm	59.25	Musa et al. 1983.	Puerto Rico	
	k	year	0004.00 (4.0*10**-4)			
	tzero	year	-522.02			
	n=45 otoliths; 3 separate redions taken					
7.	L infinity	cm	72.9	Claro and Garcia-Arteaga 1994	Northeast Zone	Hardpart Analysis
	k	year	0.09		Cuba	
	tzero	year	-2.64			
	theta		2.68			
	theta-hat					
	rings not annual					
8.	L infinity	cm	75.7	Claro and Garcia-Arteaga 1994	Southeast Zone	Hardpart Analysis
	k	year	0.1		Cuba	
	tzero	year	-2.08			
	theta		2.76			
	theta-hat					
	rings not annual					
9.	Maximum size	cm	76	Bolkle and Chaplin 1968	Bahamas	

Comments: 1) Fitting method not given; estimates of growth rate parameter (k) and tzero are suspect.
2) Authors noted difficulty in making mesuremetns in this species.
3) sample set did not contain fish at younger/smaller sizes below 12 cm FL.

Table 3. Summary information on length to length relationships for silk snapper from the literature.

1. Unsexed Fish
Regression: SL = 0.7 + 0.86 x FL
Number of fish: 47 r:
Length range (cm): 23.0-52.0 Data Ref.: Manooch and Mason 1984
Units : cm

2. Unsexed Fish
Regression: TL = 0.9 + 1.04 x FL
Number of fish: 47 r:
Length range (cm): 23.0-52.0 Data Ref.: Thompson and Munro 1974
Units : cm

3. Regression: TL = 0.0 + 1.072222 x FL
Comments: Based on measurement of picture, in MORPHMET table from ICLARM Fishbase.
Units : Cm
4Regression: TL = 0.0 + 1.229299 x SL
Comments: Based on measurement of picture, in MORPHMET table from ICLARM Fishbase.

Table 4. Summary information on weight to length relations for Silk snapper from the literature.

	Equation		Sample Size	Study Area	Length Range(cm)	Sampling Dates
1.	Tabash and Sierra(1996):	Weight (grams)= 0.00009 * Fl (mm)** 2.91	n=200 fish r-square =0.90	Costa Rica	18-54	9/1992 to 11/1994
2.	Sylvester and Dammann 1973:	Log Weight(kg) = -3.47058 + (2.41350*Log(Fl cm)	n=35 fish	U.S. Virgin Islands, Anegada, Virgin Gorda		
3.	Boardman and Weiler 1979	Log Weight(grams)= 3.10 * Log (Fl mm) - 5.00	n=30; r=0.99	Puerto Rico		
4.	Sylvester et al. (1980):	No equation given, tables of raw lenth data presented figures of w-l equation presented	n=95	U.S. Virgin Islands		
5.	Musa et al. 1983	Log Weight(grams)= 2.92 * log (FL Cm) - 4.60 Parameter estimates are suspect	n=121	Puerto Rico	12-39	1977-1979
6a.	Bohnsack and Harper 1988	Log Weight(grams)= -4.2096 + (2.781 * log (Fl mm))	n=165	St. Croix	22-65	
6b.	Bohnsack and Harper 1988	Log Weight(grams)= -4.6001 + (2.913 * log (Fl cm))	n=36	St. Thomas/St. John	20-64	
6c.	Bohnsack and Harper 1988	Log Weight(grams)= -5.3646 + (3.237 * log (Fl cm))	n=181	Puerto Rico	15-40	
		Log Weight(grams)= log a + b(log FL (mm) from Bohnsack and Harper 1988, pg. 9				
7.	Claro and Garcφa-Arteaga 1994	Log Weight(grams)=0.0166* log (Fl cm) - 3.03		Cuba (Southeast)	19-56	
8.	Duarte et al. 1999	Log Weight(grams)=0.0456* log (Fl cm) - 2.8	n=18	Colombia	10.2-31	1995-1998

Table 5. Summary information on length to length relationships for queen snapper from the literature

Sex of fish: unsexed

Regression: SL(cm)= 0.0 + 0.7664233 x TL (cm)
Number of fish: 2 r:
Length (cm): 42.0-95.0 TL Data Ref.:
Comments: Derived from data in the BRAINS table in Fishbase.
Units : cm

Sex of fish: unsexed
Regression: TL(cm) = -0.986 + 1.159 x FL(cm)
Number of fish: 394 r:0.964
Length (cm): Data Ref.: Murray and Moore 1992 .
Comment: 1987 samples off Saint Lucia between August and November.
Units : cm

Table 6. Summary information on weight to length relations for queen snapper from the published literature.
Equation: log(Total weight (grams)) = log a + b (log Fl cm)

a	b	Length range			n	Country	Location	Reference
0.0233	2.55	36.0	- 89.0	FL	21	US Virgin Is	St. Thomas/St. John	Bohnsack and Harper 1994
0.0173	2.578	20.0	- 70.0	FL	48	US Virgin Is	St. Croix	Bohnsack and Harper 1994
0.0632	2.771				62	Saint Lucia		Murray and Moore 1992

Table 7. Summary information on length to age relationship for queen snapper from the literature.

	Parameter	unit	Value	Referemce	Country	Sampling Dates	Analytical Methods
	L infinity	cm	102.0	Murray and Moore 1992	Saint Lucia	Sampled 1/1987-12/1987	ELEFAN I as implement in FiSAT (Gayanilo et al. 1996)
	k	year	0.29				monthly samples taken
	theta-prime		3.48				
2.	L infinity	cm	103.2	Murray 1992	Saint Lucia		
	k	year	0.61				
	tzero	year					
	Comment: Reference not found but as cited in Murray and Nelson 2002.						
3.	Reference:			Murray and Neilson 2002			
	k	year	1.078 +/- 0.687		Saint Lucia		Modification of method of Murray 1989 (quasi-Gulland and Holt (1959) plot method) where:
	k	year	0.621 +/- 0.076				regression of daily growth incremetns on mid-point of otolith segment (increment) to focus
Notes: This study did not derive estimates of the asymptotic size, L Infinity.							
4.	k	year	0.71	Murray 1989	Saint Lucia		Elefan
Notes: This study did not derive estimates of the asymptotic size, L Infinity.							