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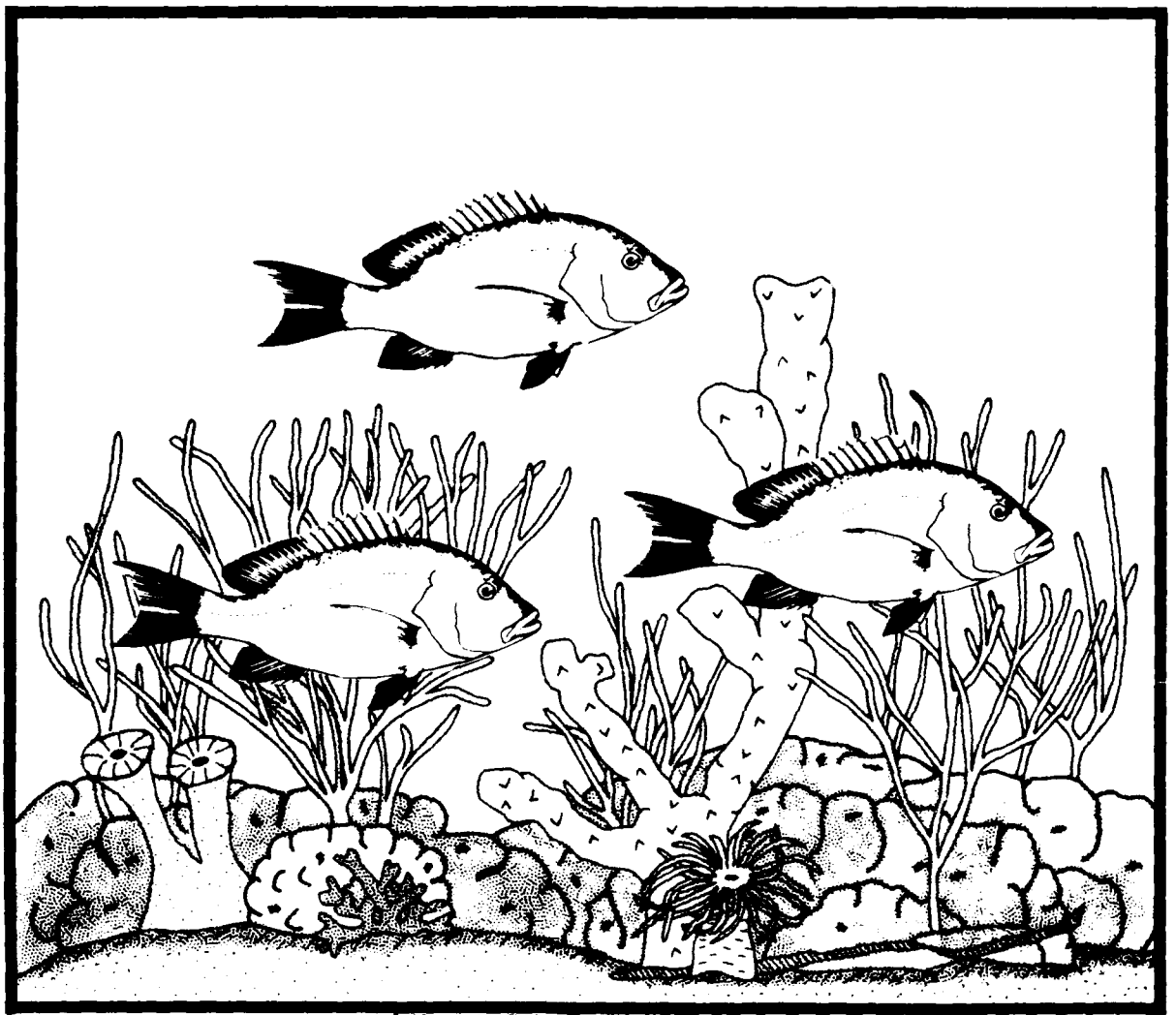

Fish and Wildlife Service
U.S. Department of the Interior

Coastal Ecology Group
Waterways Experiment Station
U.S. Army Corps of Engineers

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Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Gulf of Mexico)

RED SNAPPER

by

David Moran
U.S. Fish and Wildlife Service
National Wetlands Research Center
1010 Gause Boulevard
Slidell, LA 70458

Project Officer
David Morais
U.S. Fish and Wildlife Service
National Wetlands Research Center

Performed for
Coastal Ecology Group
Waterways Experiment Station
U.S. Army Corps of Engineers
Vicksburg, MS 39180

U.S. Department of the Interior
Fish and Wildlife Service
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National Wetlands Research Center
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PREFACE

This species profile is one of a series on coastal aquatic organisms, principally fish, of sport, commercial, or ecological importance. The profiles are designed to provide coastal managers, engineers, and biologists with a brief comprehensive sketch of the biological characteristics and environmental requirements of the species and to describe how populations of the species may be expected to react to environmental changes caused by coastal development. Each profile has sections on taxonomy, life history, ecological role, environmental requirements, and economic importance, if applicable. A three-ring binder is used for this series so that new profiles can be added as they are prepared. This project is jointly planned and financed by the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service.

Suggestions or questions regarding this report should be directed to one of the following addresses.

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Boulevard
Slidell, LA 70458

or

U.S. Army Engineer Waterways Experiment Station
Attention: WESER-C
Post Office Box 631
Vicksburg, MS 39180

CONVERSION TABLE

Metric to U.S. Customary

Multiply	By	To Obtain
millimeters (mm)	0.03937	inches
centimeters (cm)	0.3937	inches
meters (m)	3.281	feet
meters (m)	0.5468	fathoms
kilometers (km)	0.6214	statute miles
kilometers (km)	0.5396	nautical miles
square meters (m^2)	10.76	square feet
square kilometers (km^2)	0.3861	square miles
hectares (ha)	2.471	acres
liters (l)	0.2642	gallons
cubic meters (m^3)	35.31	cubic feet
cubic meters (m^3)	0.0008110	acre-feet
milligrams (mg)	0.00003527	ounces
grams (g)	0.03527	ounces
kilograms (kg)	2.205	pounds
metric tons (t)	2205.0	pounds
metric tons (t)	1.102	short tons
kilocalories (kcal)	3.968	British thermal units
Celsius degrees (°C)	1.8(°C) + 32	Fahrenheit degrees

U.S. Customary to Metric

inches	25.40	millimeters
inches	2.54	centimeters
feet (ft)	0.3048	meters
fathoms	1.829	meters
statute miles (mi)	1.609	kilometers
nautical miles (nmi)	1.852	kilometers
square feet (ft^2)	0.0929	square meters
square miles (mi^2)	2.590	square kilometers
acres	0.4047	hectares
gallons (gal)	3.785	liters
cubic feet (ft^3)	0.02831	cubic meters
acre-feet	1233.0	cubic meters
ounces (oz)	28350.0	milligrams
ounces (oz)	28.35	grams
pounds (lb)	0.4536	kilograms
pounds (lb)	0.00045	metric tons
short tons (ton)	0.9072	metric tons
British thermal units (Btu)	0.2520	kilocalories
Fahrenheit degrees (°F)	0.5556 (°F - 32)	Celsius degrees

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FIGURES

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ACKNOWLEDGMENTS

I am grateful for reviews by Russell Nelson, Florida Marine Fisheries Commission, Tallahassee; Charles Manooch III, National Marine Fisheries Service, Beaufort, North Carolina; and John Finucane, Churchill Grimes, and Allan Collins of the National Marine Fisheries Service, Panama City, Florida.

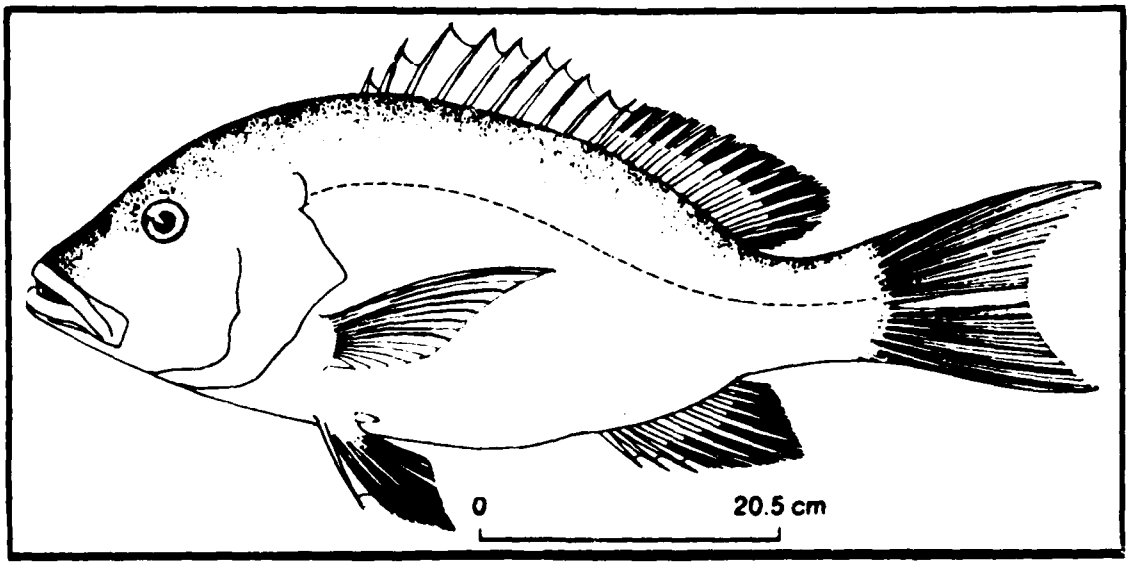

Figure 1. Adult red snapper Lutjanus campechanus (from Vergara-R. 1978).

RED SNAPPER

NOMENCLATURE/TAXONOMY/RANGE

Scientific name...Lutjanus campechanus
Preferred common name....Red snapper (Figure 1)
Other common names.....Sow snapper, rat snapper (northwest coast of Florida); mule snapper, chicken snapper (northeast coast of Florida); gulf red snapper, American red snapper
Class.....Osteichthyes
Order.....Perciformes
Family.....Lutjanidae

Geographic range: the continental shelves bordering the Gulf of Mexico (Figure 2) and the Atlantic Coast as far north as Cape Hatteras, North Carolina; not reported in the Caribbean Sea (Rivas 1966, 1970).

MORPHOLOGY/IDENTIFICATION AIDS

The following descriptions are taken from Rivas (1966), Anderson (1967), and Vergara-R. (1978). Anderson's description includes fish that are Caribbean red snapper, Lutjanus purpureus, which he considered to be conspecific with L. campechanus; he suggested the name L. aya for the composite. The name L. blackfordii is an obsolete name for the red snapper.

Distinguishing Characters of Red Snapper

Dorsal fin IX-X spines, usually X, 13-15 soft rays, usually 14; anal fin III-IV, usually III, 8-10, usually 9; pectoral fin rays 15-18, usually 17; scales on lateral line usually 45-47; gill rakers on lower limb of anterior arch (excluding rudiments) 9. Head large; lower jaw projecting slightly beyond upper; snout somewhat pointed; eyes small, contained more than 6.5 times in head length; interorbital region convex in the transverse plane; anchor-shaped patch of strong teeth on roof of mouth, a posterior median extension of the patch moderately

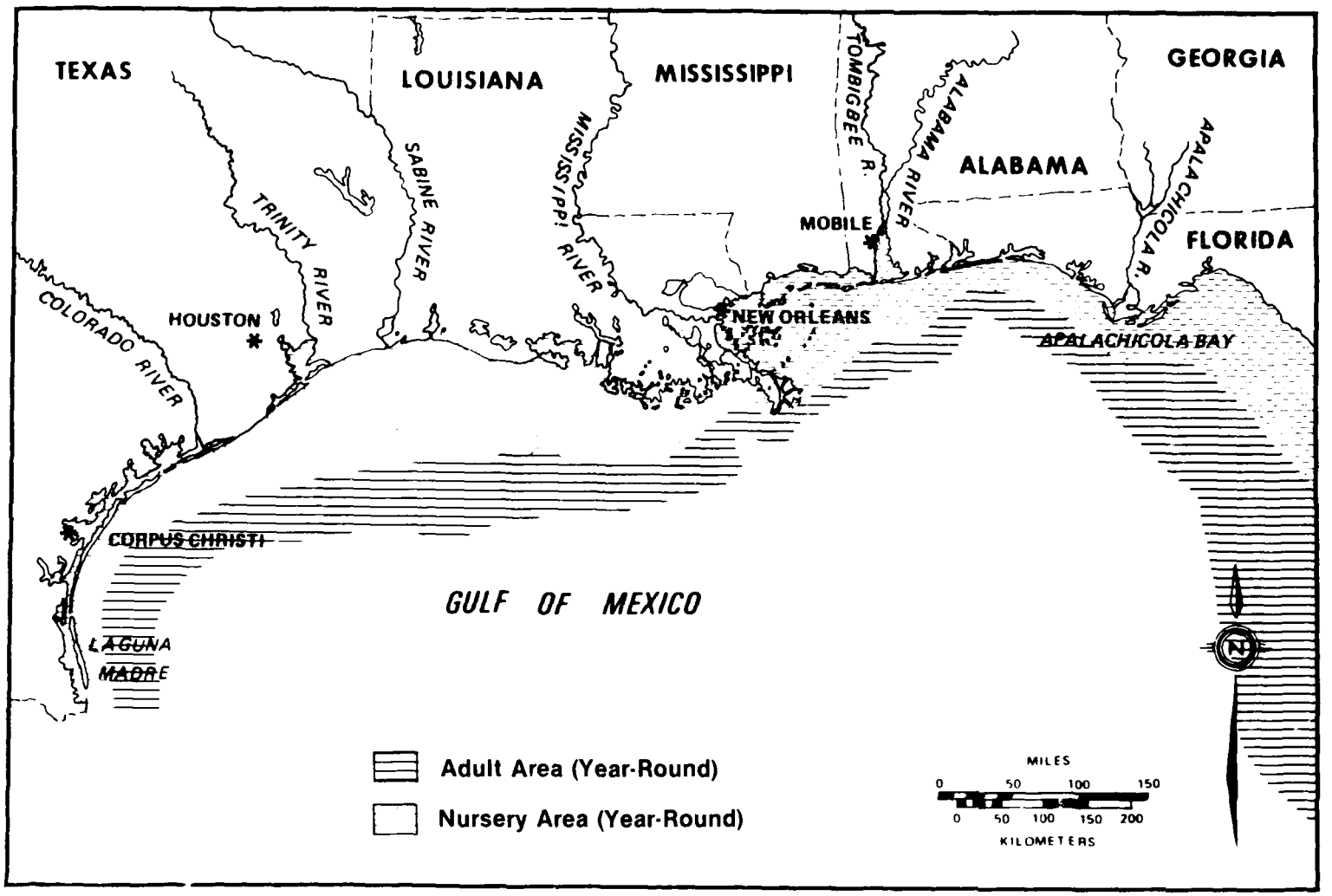

Figure 2. Distribution of juvenile and adult red snapper in the Gulf of Mexico (from National Oceanic and Atmospheric Administration 1985).

developed. Pectoral fins long, reaching to anus when pressed against body; anal fin angulate in specimens longer than 50 mm; margin of caudal fin deeply notched.

Color: back and upper sides brick red to scarlet; lower sides and belly rose-colored to white, especially in front. Iris of eye red. Dark spot on upper area of each side below anterior soft dorsal fin rays, disappearing in specimens over 250 mm long. Occasional bluish stripes on sides of juveniles.

Distinguishing Characters of Similar Species from the Same General Area

Lutjanus vivanus (silk snapper): body color pink to red; iris of eye yellow; 8 soft rays in anal fin.

Lutjanis analis (mutton snapper): tooth patch on roof of mouth chevron-shaped, without a posterior extension; back, upper sides, and upper lobe of caudal fin olive green; two blue stripes on snout and cheek; dark spot on each side below soft rays of dorsal fin persisting throughout life.

Lutjanis purpureus (Caribbean red snapper): occurring only in the Caribbean Sea and in the Atlantic coastal waters of South America.

All other species of Lutjanus: anal fin rounded and color patterns different from L. campechanus.

Pristipomoides aquilonaris (wenchman): back and upper sides rose to pink; interorbital region flat; snout short and blunt; tooth patch on roof of mouth triangular or chevron-shaped, without a posterior extension; only 10-11 soft rays in dorsal fin.

Rhomboplites aurorubens (vermilion snapper): back and upper sides vermilion; tooth patch on roof of mouth rhomboid; dorsal fin XII to XIII, 10-11.

REASONS FOR INCLUSION IN THE SERIES

The red snapper is the most important fish in the commercial snapper-grouper fishery between Cape San Blas, Florida, and the mouth of the Rio Grande (Allen and Tashiro 1976); 4.6 million lb were landed commercially at U.S. ports in the Gulf of Mexico in 1985 (National Marine Fisheries Service 1986, unpubl. data). The red snapper ranked 19th in number of fish caught among groups of sport fish for which statistics were recorded in the Gulf of Mexico in 1985; about 2 million red snapper were caught by sport fishermen in the gulf that year (National Marine Fisheries Service 1986a).

LIFE HISTORY

Spawning

Red snapper usually show partial sexual maturity when 1 year old and show full maturity when about 2 years old and 375 mm in fork length (FL) (Table 1).

In general, red snapper spawn in summer and fall in the Gulf of Mexico. They have one peak spawning period in Florida waters and two peaks in Texas waters (Table 2).

Individual fish probably spawn several times during the spawning season (several egg stages occur simultaneously in the ovaries); the protracted spawning season and variation in gonadosomatic indices in fish of similar size during the season are consistent with this hypothesis (Collins et al. 1987).

The fish spawn primarily away from reefs (Bradley and Bryan 1975). Spawning was reported at depths of 18-37 m over a firm sand bottom with little relief (Beaumariage and Bullock 1976).

Fecundity of fish sampled in northwest Florida ranged from 0.2 million

Table 1. Estimated length and age at maturity of red snapper in the Gulf of Mexico.

Age at partial maturity	Age at full maturity	Length at partial maturity	Length at full maturity	Total fish sampled	Reference
1[a]	b	325 mm(FL)[a]	b	b	Camber (1955)[c]
b	2	b	375 mm(FL)	298	Collins et al. (1986) and Nelson and Manooch (1982)[d,e]
b	2	b	b	559	Futch and Bruger (1976)[e,f]

[a]Females.
[b]No data.
[c]Maturity was determined by macroscopic examination of ovaries.
[d]Age was determined mostly from scale annuli. Maturity was determined by macroscopic and microscopic examination of ovaries and calculation of the gonadosomatic index.
[e]The monthly distribution of marginal incremental growth beyond the last annulus was used to determine that annuli are formed annually.
[f]Age was determined from otolith annuli. Maturity was determined by macroscopic examination of ovaries.

eggs for a female about 3 years old and 386 mm FL to 9.3 million for a fish about 12 years old and 754 mm FL (Collins et al. 1987).

Eggs

Red snapper eggs average 0.82 mm in diameter (range: 0.77-0.85 mm). The egg is pelagic, spherical, unpigmented, and transparent, and has a single oil globule (Raibalais et al. 1980). In the laboratory, initial hatching began 20 h after fertilization (Minton et al. 1983), and about 50% of the eggs hatched within 25 h of fertilization (Raibalais et al. 1980).

Larvae

Newly hatched larvae in the laboratory averaged 2.2 mm in standard length (SL) according to Raibalais et al. (1980). The larvae began actively feeding on culture of alga and rotifers 3 days after hatching and were 2.5 mm SL 4 days after hatching (Raibalais et al. 1980). Lutjanid larvae collected in the field could be identified only to family by Collins et al. (1980), who also reported that the head was proportionately large and head length was about equal to body depth for red snapper larvae and juveniles 4-22 mm SL.

Juveniles and Adults

The peak abundance of juveniles is in shallower water (20-46 m deep) than the peak density of adults (Figure 2; Bradley and Bryan 1975). Juvenile red snapper were caught in trawls on the Texas shrimp grounds (Bradley and Bryan 1975).

Table 2. Spawning periods of red snapper in the Gulf of Mexico.

Region	Spawning season(s)	Peak	Number of fish sampled	Reference
Texas	May to July and November to December	May to July and November	569	Bradley and Bryan 1976[a]
West Florida	July to October	August to September	314	Futch and Bruger 1976[a]
Northwest Florida	May to September	July	729	Collins et al. 1986[b]

[a]On the basis of macroscopic examination of ovaries.
[b]On the basis of gonadosomatic index and both macroscopic and microscopic examination of ovaries.

Instantaneous natural mortality (M) was estimated to be 0.19 in West Florida and 0.20 in Louisiana by Nelson and Manooch (1982). They also reported that instantaneous total mortality (Z) was estimated at 0.78 or 0.94 in Louisiana (depending on the method of calculation) and 0.42 or 0.44 along the west coast of Florida. They determined Z by sampling commercial catches.

Movement

Adult red snapper remain in their reef habitations during cooler months. Tagging studies generally indicate little movement, particularly when the fish are released in water less than 14 m deep (Topp 1963; Beaumariage and Wittich 1966; Beaumariage and Bullock 1976; Fable 1980). Adult red snapper sometimes move close to shore in summer; they were collected in trawls in the lower parts of the St. Andrew Bay system, Florida, in summer and fall but not in winter and spring (Ogren and Brusher 1977). Occasional tagged adults were caught 5-150 nmi from the point of release after 29-1,163 days of freedom (Beaumariage and Wittich 1966; Moe 1963; Beaumariage 1969).

GROWTH CHARACTERISTICS

Red snapper initially grow quickly and then growth slows steadily as larger size associated with long life span expectancy is reached. They grow from 137-177 mm TL at age 1 to 538-546 mm TL at age 5 and 784-794 mm TL at age 11 (Table 3). They may reach 845 mm FL and 12 kg (Bradley and Bryan 1975) and an age of about 13 years (Nelson and Manooch 1982). Variation is considerable but is similar at each age, probably because of the protracted spawning season (Futch and Bruger 1976). Red snapper ages were determined with similar results using otoliths, scales, and vertebrae of fish off Alabama (Bortone and Hollingsworth 1980), and using otoliths and scales of fish off the Carolinas (Nelson and Manooch 1982). Scale annulus formation off the U.S. gulf coast is complete by early summer for fish ages 2 and older (Parrack 1986a).

In the gulf, underyearling fish grew 25 mm/month in August and September

Table 3. Length (mm) at age (years) of red snapper in four regions of the Gulf of Mexico.

Northwestern gulf[a]		Louisiana[b,c]		Alabama[b,d]		Western Florida[b,c]	
Age	SL	Age	TL	Age	TL	Age	TL
0+	100	1	137	1	168	1	177
1+	250	2	267	2	239	2	298
2+	350	3	379	3	321	3	390
3+	425	4	469	4	401	4	470
4+	575	5	546	5	535	5	538
		6	613	6	631	6	597
		7	665	7	749	7	642
		8	707	8	835	8	675
		9	751	9	843	9	723
		10	783			10	762
		11	794			11	784
		12	891				
		13	906				

[a]Moseley (1966). Most fish were taken in winter. Age was determined from scale annuli. Lengths include part-year increments after formation of the last annulus. Total sample size was 243 fish.
[b]Back-calculated lengths.
[c]Nelson and Manooch (1982). Age was usually determined from scales (sometimes also from otoliths). Total sample size was 443 fish for western Florida and 402 fish for Louisiana.
[d]Wade (1981). Age was determined from scale annuli. Total sample size was 238.

according to Bradley and Bryan (1975). Annual growth of fish of ages I to IV or V in the gulf ranged from 60 to 75 mm (Bradley and Bryan 1975) to 90 mm (Moseley 1966).

The relations of SL to FL and FL to TL (lengths in mm) and N (sample size) were reported by Futch and Bruger (1976) as follows:

$$FL = 1.1585\ SL + 13.3\ (N = 21)$$
$$TL = 1.0678\ FL + 3.5\ (N = 100).$$

Nelson and Manooch (1982) reported the following relation:

$$TL = 1.0712\ FL + 1.7\ (N = 180).$$

Additional length-length relations are given in Parrack (1986b). Length-length relations show a high linear correlation (Parrack 1986b).

Length-weight relations calculated for several areas in the gulf were similar (Table 4; Parrack 1986b). The length-weight relation changed at 190-300 mm SL (Moseley 1966).

Nelson and Manooch (1982) reported von Bertalanffy growth equations for fish from two areas in the gulf as follows (L_t = TL in mm and t = age in years):

Louisiana:
$$L_t = 950(1-e^{-0.175(t-0.10)})$$

West Florida:
$$L_t = 941(1-e^{-0.170(t+0.10)})$$

Table 4. Length (mm)-weight (g) relations for red snapper.

Region	Equation	Reference
West Florida	$\log_{10}W = 2.966 \log_{10}FL - 4.7399$	Nelson and Manooch (1982)[a]
Florida Males:	$\log_{10}W = 3.008 \log_{10}FL - 4.8104$	Futch and Bruger (1976)[b]
Females:	$\log_{10}W = 3.028 \log_{10}FL - 4.8618$	
Alabama	$\log_{10}W = 3.0092 \log_{10}TL - 4.8539$	Wade (1981)[c]
Texas	$\log_{10}W = 2.885 \log_{10}FL - 4.483$	Wakeman et al. (1979)[d]
Campeche (for fish 90-190 mm FL)	$\log_{10}W = 3.01 \log_{10}FL - 4.7921$	Camber (1955)[e]

[a]N = 143.
[b]N = 240.
[c]N = 722.
[d]N = 90.
[e]N not given.

They found that the von Bertalanffy growth curves for Louisiana, western Florida, eastern Florida, and the Carolinas differed statistically, as did the length-weight relations for fish from west Florida, east Florida, and the Carolinas. However, the differences in growth curves were small and the differences in length-weight curves had little if any biological significance. Parrack (1986a) reported differences in growth curves between fish west of and fish east of the Mississippi Delta. This difference was inconclusive, however (Reef Fish Scientific Task Team and Special Scientific and Statistical Committee 1987).

FISHERIES

Snappers are especially vulnerable to fishermen because, during cooler months, the fish will remain in a fishing area (reef habitat) until it is overfished (Duffy 1970), and sometimes rise to the surface and snap at bare hooks or whatever is offered--hence the name "snapper" (Stearns 1885).

Fishing mortality in the gulf varies with location. Nelson and Manooch (1982) estimated instantaneous fishing mortality to be 0.58 or 0.74 in Louisiana (depending on the method of calculation) and 0.23 or 0.25 in west Florida. Mean age of the total catch was less in Louisiana (2.4 years) than in west Florida (4.1 years), possibly because of the heavier fishing pressure in Louisiana. Fishing mortality was higher in Louisiana partly because the fishing reefs are closer to shore there and thus more accessible (Nelson and Manooch 1982).

About 2,300 oil production platforms off the Louisiana coast enhance snapper fishing by providing three-dimensional habitat (St. Amant 1976); it has not been determined if artificial habitat primarily increases or mostly just redistributes adult populations.

The total standing stock for all species of snappers along the South Atlantic and gulf coasts of the United States was estimated at 350 million lb (Klima 1976). Red snapper landings were worth about 1% of the value of

all finfish landed commercially in the United States in 1985 (National Marine Fisheries Service 1986b). The number of red snapper caught by sport fishermen was about 1% of the total number of fish of all species caught in the recreational fisheries of the Atlantic and gulf coasts in 1985 (National Marine Fisheries Service 1986a).

Commercial Fishery

Snappers and groupers are often taken together in the snapper-grouper fishery. Various fishing methods for snappers and groupers have been used or tested over the years. Most commercial fishing is done with baited hooks and lines on electric and hydraulic reels which were too expensive until recently (Churchill Grimes, National Marine Fisheries Service, Panama City, Florida; pers. comm.). (These are all classified as handlines in National Marine Fisheries Service fishery statistics.) From 2 to 40 hooks may be used with one reel (Allen and Tashiro 1976). Ladyfish and squid are the most effective bait (Carpenter 1965); red snapper select fish and squid equally often (Futch and Bruger 1976). The industry has experimented with other fishing methods, but many were deficient; an otter trawl adapted for rough bottoms was effective, however (Smith 1948; Captiva and Rivers 1960; Nelson and Carpenter 1968). An extensive bottom longline fishery that may take red snapper has developed in the Gulf of Mexico since about 1980 (Russell Nelson, Florida Marine Fisheries Commission, Tallahassee; pers. comm.). The longline fishery in the eastern gulf has been directed primarily at yellowedge grouper (Epinephelus flavolimbatus) (Parrack and McClellan 1986).

Commercial fishing grounds for red snapper are well offshore in the Gulf of Mexico (Figure 3). In 1955, the most important fishing grounds had long been the Campeche Banks off the Yucatan Peninsula, Mexico, which were the principal grounds fished by the west Florida fleet (Camber 1955; Hildebrand 1955). Fishing there by American boats has been curtailed, however, since the extension of Mexico's fishery conservation zone to the 200-mi limit (Deborah Fable, National Marine Fisheries Service, Panama City, Florida; pers. comm.). Red snapper landings from foreign waters have composed less than 13% of the total U.S. landings since 1973 (Gulf of Mexico Fishery Management Council 1981).

Western Florida landings varied widely over the years (Figure 4; Camber 1955). They increased progressively as the fishery developed from 1880 to 1902, stabilized as the Campeche Banks were exploited during 1902-28, dropped with reduced effort during the Great Depression of 1929-35, increased again as the economy began to recover in 1936-39, declined markedly with reduced effort from 1939 to 1945 during World War II, and then began to recover again around 1946 (Figure 4; Camber 1955).

In the early 1960's, large numbers of commercial vessels were built to fish for snappers and groupers (Carpenter 1965). The average number of handline vessels in western Florida was 180 in 1957-60; increased to 290 in 1961-65; leveled off at 260 in 1966-70; and increased again to 320 in 1971-74. The average total number of handline fishermen in western Florida was 780 in 1957-60; increased to 1200 in 1961-65; and stabilized at 1030-1100 in 1967-74 (Florida Sea Grant College 1980; Gulf of Mexico Fishery Management Council 1981).

Landings for western Florida declined greatly during 1982-85 to the second-lowest level ever recorded (Figure 4). In 1983-85 catch per unit of effort (catch rate) was relatively high, but declined 26% during that period in the gulf east of the Mississippi River Delta for fish 3

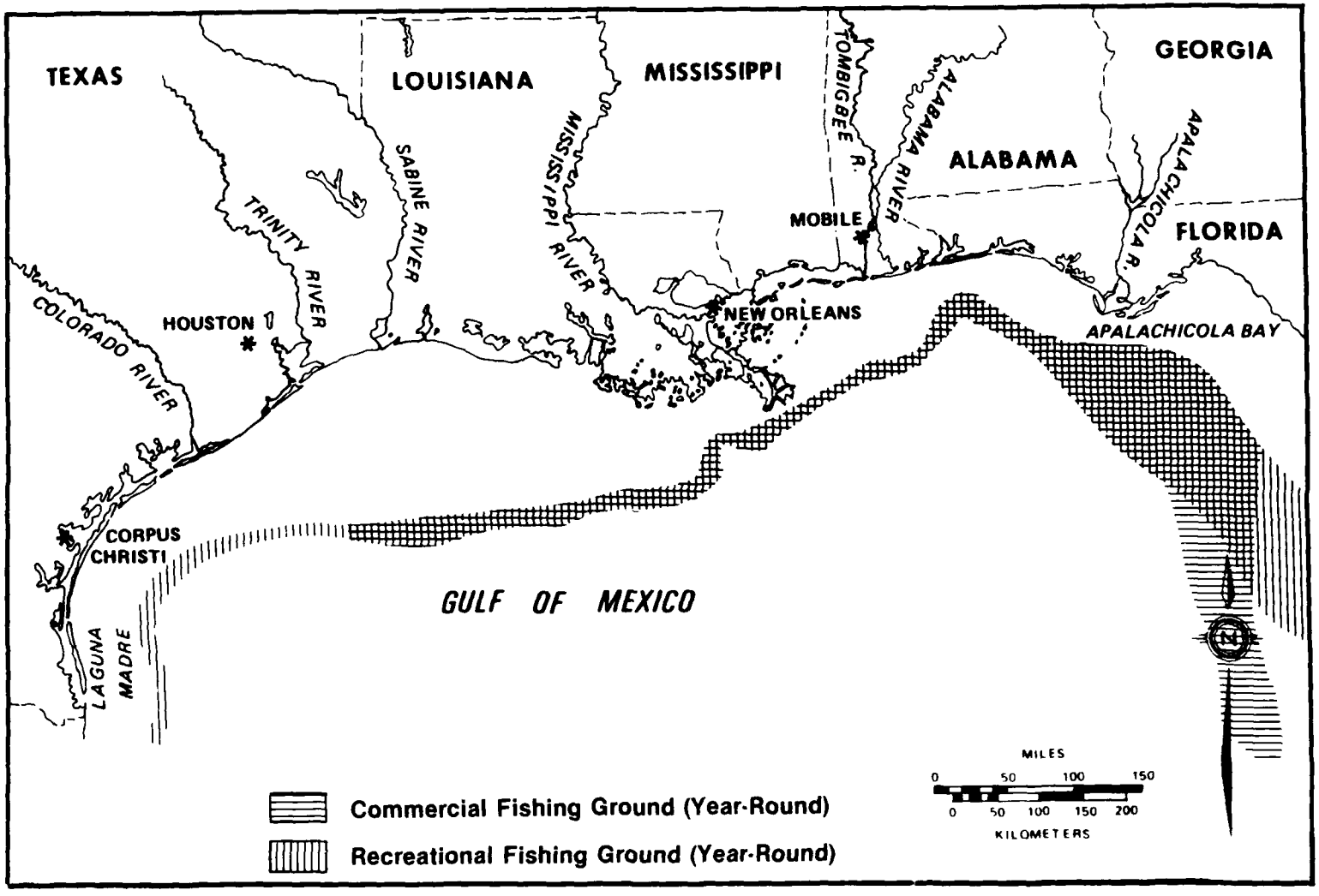

Figure 3. Commercial and sport fishing grounds for red snapper in the Gulf of Mexico (from National Oceanic and Atmospheric Administration 1985).

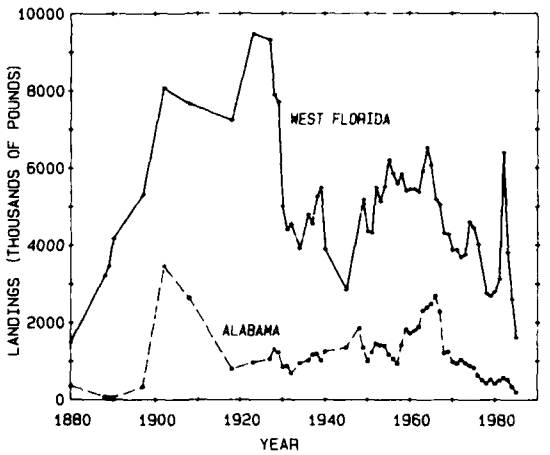

Figure 4. Annual commercial landings of red snapper (in millions of pounds) in Florida and Alabama, 1880-1985 (from U.S. Fish and Wildlife Service 1967; National Marine Fisheries Service [1986], unpubl. data).

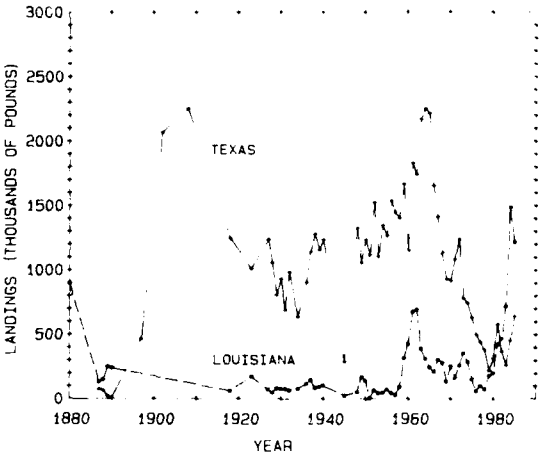

Figure 5. Annual commercial landings of red snapper (in millions of pounds) in Louisiana and Texas, 1880-1985 (from U.S. Fish and Wildlife Service 1967; National Marine Fisheries Service, unpubl. data).

years old and older in the bottom-longline and rod-and-reel fisheries (Parrack and McClellan 1986). Also in 1983-85, a recent stock assessment showed that initial biomass (without recruits) declined 17% and recruitment biomass declined 98% in this area (Parrack and McClellan 1986).

The principal commercial fishing grounds used by fishermen from Alabama, Mississippi, Louisiana, and Texas are on the reefs offshore from those States (Figure 3). The average number of handline vessels in Alabama, Mississippi, Louisiana, and Texas together was 150 in 1957-60 and 180 in 1961-55; declined to 90 in 1966-70; and levelled off at 80 in 1971-74. The average size of the vessels increased from 30 gross tons in 1957 to 61 gross tons in 1974 (Florida Sea Grant College 1980; Gulf of Mexico Fishery Management Council 1981). Landings peaked in the early 1960's in Alabama and Texas (Figures 4-5), and in 1968 in Mississippi (Figure 6). Landings in Alabama, Texas, and Mississippi declined 73%-93% after these peaks in the 1960's (Figures 4-6), but Louisiana landings increased to a record high in 1984 (Figure 5). A recent stock assessment showed that estimated initial biomass (without recruits) declined 45%, but estimated recruitment biomass increased 21%, for red snapper west of the Mississippi River Delta between 1980 and 1985 (Parrack and McClellan 1986).

An increase in the number of fishing boats and trips may cause competition among boats, because the number of boats that can make a good catch in the prime fishing areas is limited; competition among boats reduces the catch per unit of fishing effort. On the Campeche Banks, the catch rate (catch per unit effort) declined from 1937 to 1940, when the number of fishing trips (and probably, therefore, the competition) increased, and then increased greatly from 1941 to 1945 when competition probably declined because of reduced fishing effort during World War II. The catch rate

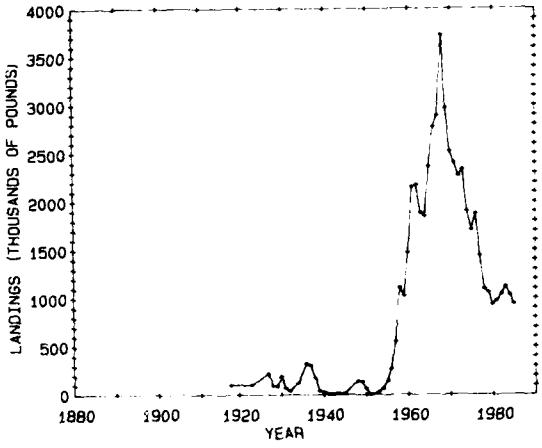

Figure 6. Annual commercial landings of red snapper (in millions of pounds) in Mississippi, 1920-1985 (from U.S. Fish and Wildlife Service 1967; National Marine Fisheries Service, unpubl. data).

declined from 1948 to 1951, but competition probably also declined (Camber 1955).

Red snapper and associated species are usually gutted when caught (Carpenter 1965) and are stored in ice aboard the vessels (rather than in live wells)--a practice that began in the late 19th century (Warren 1897). At least 10 species are marketed as red snapper (Rivas 1966).

In the commercial fisheries for finfish and shellfish in the gulf, the red snapper fishery ranks eighth in total weight, seventh in total value, and sixth in price per pound (National Marine Fisheries Service 1986b and unpubl. data). The only species regularly exploited by offshore fisheries in the western gulf are the red snapper and gulf menhaden, Brevoortia patronus (Hildebrand 1954). The red snapper is the most important of about 17 species in the U.S. snapper fishery (Allen and Tashiro 1976). In the northern gulf, it made up about 86% of the total value of the catch by the large vessels (56-ft to 69-ft long) in the snapper-grouper fishery that could reach distant fishing grounds, and in the southeastern gulf, it made up about 37% of the total value of the catch by all vessels in the fishery (Cato and Prochaska 1976). At the time of Cato and Prochaska's study, the Campeche Banks were not fished substantially by American boats for political reasons. Total profits were greater for the larger vessels in the northern gulf because the value per pound was higher for red snapper than for the other species that predominated in the southeastern gulf (Cato and Prochaska 1976).

Sport Fishery

The red snapper is one of the most desired species of sport fish in the gulf. Sportfishing grounds overlap commercial grounds (Figure 3). In 1965 and 1970, the weight of the commercial catch was less than that of the sport catch (Nakamura 1976). Sportfishing boats range from small 12-ft private boats to 85-ft party boats (head boats). The number of boats increased from 1956 to 1976 and probably partly displaced the inshore commercial fishery (Allen and Tashiro 1976; St. Amant 1976).

Between 1982 and 1985, the gulf coast sport fishery catch of red snapper declined by about 60% in Florida and 78% in Louisiana (Table 5). In western Florida, the commercial catch also declined sharply between 1982 and 1985. In Louisiana, the commercial fishery may have supplanted the recreational fishery over this period (Figure 5).

The largest annual sport catch for Louisiana from 1979 (when accurate statistics became available) to 1985 was about 2.7 million fish--the highest recorded for any gulf state for the same time period (Table 5). For that period, Alabama's sport catch fluctuated with high catches about

Table 5. Recreational catch of red snapper (thousands of fish) in the Gulf States, 1979-85 (from National Marine Fisheries Service 1984, 1985a, 1985b, 1986).

Year	Florida Gulf Coast	Alabama	Mississippi	Louisiana	Texas
1979	1,746	1,306	<30	823	2,156
1980	847	79	51	1,572	1,597
1981	558	1,003	a	2,697	642
1982	805	611	<30	2,348	a
1983	354	1,349	<30	1,957	a
1984	126	459	<30	701	<30
1985	297	453	<30	523	680

[a]No data.

every other year; in years between 1979 and 1985, when the sport catch was higher (1979, 1981, and 1983), the commercial catch was also generally higher--except that the commercial catch peaked in 1982. A trend in the Texas catch could not be determined because too few data were available. Mississippi's catch remained very low (Table 5), and the commercial catch in 1985 was the lowest in 17 years (Figure 6). Current regulations in the U.S. waters of the gulf allow a maximum of 5 fish less than 12 inches FL per trip for headboats.

In summary, the sport catch and commercial catch were sometimes positively correlated--possibly because both declined after heavy fishing pressure or because of a natural 30-month cycle in abundance (Camber 1955)--and sometimes negatively correlated, possibly because one fishery replaced the other (Allen and Tashiro 1976).

ECOLOGICAL ROLE

Feeding Habits

Juvenile and adult red snapper are carnivorous. Small zooplankters were common prey of juveniles up to 150 mm FL, but the fish probably start to prefer larger prey when they are about 100 mm FL (Bradley and Bryan 1976). Stomachs of juveniles most frequently contained shrimp throughout the year in the Gulf of Mexico (Camber 1955; Bradley and Bryan 1976). Other crustaceans (including crabs), fish, and squid were found in 2%-10% of the sampled fish. The types of prey that contributed the greatest percentage by volume to the diet of juveniles were squid, octopuses, and shrimp (Table 6). Juveniles and adults eat a large variety of species of molluscs, crustaceans, and fishes (Table 7).

Camber (1955) reported that adult red snapper in the Gulf of Mexico took the following prey (in decreasing order of frequency of occurrence): shrimp, small reef fish, crabs, and gastropods. He stated that tunicates may be taken in spring.

Futch and Bruger (1976) stated that red snapper may feed over sand, shell, or mud bottoms next to reefs or other rocky bottoms. Many of the prey of red snapper are found over level bottoms adjacent to the reefs, rather than on the reefs themselves (Davis 1975).

Table 6. Prey items found in the greatest frequency of occurrence in juvenile and adult red snapper and the greatest volume in juveniles in the Gulf of Mexico (from Bradley and Bryan 1976).

	Juveniles		Adults
Season	Greatest frequency of occurrence	Greatest percentage of volume	Greatest frequency of occurrence
Winter	Shrimp (25%)	Shrimp (48%)	Fish (83%)
Spring	Shrimp (6%)	Shrimp (75%)	Fish (39%)
Summer	Shrimp (53%)	Squid (41%)	Lesser blue crab (36%)
Fall	Shrimp (83%)	Octopuses (45%)	Fish (55%)

Competition, Predation, and Parasitism

The grey snapper (Lutjanis griseus) probably competitively excludes juvenile red snapper from inshore waters in some localities (Smith 1976). Sharks sometimes strike at fish being brought up by hook and line (Bradley and Bryan 1976). Parasitic leeches have been found attached to the gills of red snapper (Williams 1979).

ENVIRONMENTAL REQUIREMENTS

Temperature and Salinity

Red snapper have been taken at 13-32 °C (Rivas 1970; Roe 1976). One of a sample of seven red snapper died at 12.5 °C--near the lower tolerance limit--in a laboratory test (Moore 1973). The upper tolerance limit is about 33.5 °C (Rivas 1970). A salinity of 60 ppt was lethal to all red snapper in a laboratory test, but they survived exposure to about 45 ppt without serious effects (Huff and Burns 1981). They are marine fish and have been taken in waters of 33-37 ppt (Moseley 1966).

In the laboratory, red snapper under simulated natural conditions spawned in water of 23-25 °C and 31-34 ppt (Arnold et al. 1978).

Habitat

Red snapper are common in submarine gullies and depressions where food may accumulate and over coral reefs, rock outcrops, and gravel bottoms in the Gulf of Mexico (Stearns 1885; Klima 1976). Usually, fewer fish are supported by smooth bottom without high relief than by bottom with three-dimensional structures, such as offshore oil and gas rigs, artificial reefs, and wrecks (Johnston et al. 1976; Sonnier et al. 1976).

Depth

In Texas, juvenile red snapper moved offshore from shallow water (about 15-30 m) in summer to deep water (about 35-60 m) in winter, based on depths of capture by trawl (Moseley 1966; Bradley and Bryan 1975). The movement may be a means of avoiding cooler inshore water in winter. The actual cue for movement, however, was not a drop in water temperature, because movement occurred before the temperature declined. Nelson and Manooch (1982) reported no size segregation between shallow (<35 m) and deep (>35 m) waters off the Carolinas.

Red snapper were abundant at depths of about 40-110 m (Carpenter 1965) and

Table 7. Prey items found in stomachs of juvenile and adult red snapper in the Gulf of Mexico (from Stearns 1885, Felder 1973, Davis 1975, and Futch and Bruger 1976). This is not intended to be a comprehensive list.

Molluscs	Decapods (continued)
Bivalves	*Hepatus pudibundus*
Laevicardium pictum	*Persephona mediterranae*
Gastropods	*Ovalipes ocellatus*
Pleuroploca gigantea	*O. guadulpensis*
Aplysia wilcoxi	*Portunus gibbesii*
Tonna galea	*Callinectes similis*
Cephalopods	*C. danae*
Squid (*Loligo* sp.)	*Leptodius agassizii*
Crustaceans	*Pinnixa lunzi*
Stomatopods	*Parthinope serrata*
Squilla empusa	*Iliacantha intermedia*
S. neglecta	*Raninoides* sp.
S. deceptrix	Majid crab
S. rugosa	*Prionoplax atlantica*
Decapods	Teleostean Fishes
Alpheid shrimp	Gulf pipefish (*Syngnathus scovelli*)
Trachypenaeus constrictus	Shoal flounder (*Syacium gunteri*)
T. similis	*Sphoeroides* sp. (Puffer family)
Acetes americanus	*Gymnothorax ocellatus* (Moray family)
Sicyonia dorsalis	Inland silverside (*Menidia beryllina*)
Leptochela serratorbita	Striped mullet (*Mugil cephalus*)
Ogyrides limicola	*Prionotus* sp. (Searobin family)
Albunea paretii	Rough scad (*Trachurus lathami*)
Petrochirus diogenes	*Peprilus paru* (Butterfish family)
Pagurus impressus	Sand perch (*Diplectrum formosum*)
Dardanus sp.	Ophichthids (Snake eel family)
Scyllarus chacei	Clupeids (Herring family)

have been caught at 7-146 m (Moseley 1966; Rivas 1970).

Contaminants

Concentrations of chlorinated hydrocarbons were lower in flesh samples of red snapper than in samples of species with a higher natural oil content (>3% oil), though contaminant levels in this group, too, were low (Stout 1980). Wet red snapper fillets had an average of 0.039 ppm DDT and metabolites; the U.S. legal maximum is 5 ppm (Stout 1980). The same fillets had 0.121 ppm PCB's; the U.S. legal maximum is 3 ppm. Only one of nine samples of red snapper had detectable levels of the pesticides dieldrin and endrin.

Red snapper in an offshore oilfield were not contaminated with petroleum hydrocarbons, although 13 other species of fish were contaminated (Middleditch et al. 1979). No evidence of toxic effects was found in testes of five male red snapper from oilfields in the gulf (Scott et al. 1980).

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16. Abstract (Limit: 200 words)
The red snapper is found offshore on the Continental Shelf throughout the Gulf of Mexico. Red snappers are taken in the snapper-grouper fishery, usually with baited hooks. The red snapper commercial fishery currently ranks seventh in total value among commercial catches of finfish and shellfish in the gulf. Red snapper are also a target of a large sport fishery. The most important prey of red snapper are fish, squid, and crustaceans. In general, red snapper spawn in summer and fall in the Gulf of Mexico. The peak abundance of juveniles occurs in shallower water (20-46 m) than does the peak abundance of adults. Adult red snapper do not move from their reef habitations during the cooler months, and during that time will remain in a fishing area until it is fished out. Fish 1 to 5 years old grow 60-90 mm SL/year. Red snapper may reach a fork length of 845 mm, a weight of 12 kg, and an age of 13 years.

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Fisheries
Life cycles
Marine fishes
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