Seafood Watch
Seafood Report

MONTEREY BAY AQUARIUM®

Spanish mackerel
Scomberomorus maculatus

King mackerel
Scomberomorus cavalla

Southeast Region

Final Report
10/06/04

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About Seafood Watch® and the Seafood Reports

Monterey Bay Aquarium's Seafood Watch® program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch® defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. Seafood Watch® makes its science-based recommendations available to the public in the form of regional pocket guides that can be downloaded from the Internet (seafoodwatch.org) or obtained from the Seafood Watch® program by emailing seafoodwatch@mbayaq.org. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Each sustainability recommendation on the regional pocket guides is supported by a Seafood Report. Each report synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's conservation ethic to arrive at a recommendation of "Best Choices", "Good Alternatives" or "Avoid." The detailed evaluation methodology is available upon request. In producing the Seafood Reports, Seafood Watch® seeks out research published in academic, peer-reviewed journals whenever possible. Other sources of information include government technical publications, fishery management plans and supporting documents, and other scientific reviews of ecological sustainability. Seafood Watch® Fisheries Research Analysts also communicate regularly with ecologists, fisheries and aquaculture scientists, and members of industry and conservation organizations when evaluating fisheries and aquaculture practices. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, Seafood Watch's sustainability recommendations and the underlying Seafood Reports will be updated to reflect these changes.

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Reports in any way they find useful. For more information about Seafood Watch® and Seafood Reports, please contact the Seafood Watch® program at Monterey Bay Aquarium by calling 1-877-229-9990.

Disclaimer

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Executive Summary

Spanish mackerel (*Scomberomorus maculatus*) and king mackerel (*Scomberomorus cavalla*) are schooling, pelagic fishes found in the western Atlantic and Gulf of Mexico. Spanish and king mackerel are primarily caught in the South Atlantic and Gulf of Mexico, where they support important commercial and recreational fisheries. The life history characteristics of Spanish mackerel make them inherently resilient to fishing pressure. Spanish mackerel are not overfished, and not experiencing overfishing in either the South Atlantic or Gulf of Mexico; these stocks are considered healthy. The primary gear used to harvest Spanish mackerel are gillnets; marine mammal bycatch in the gillnet fishery is a moderate conservation concern. Gillnets have minimal habitat effects, which rates as a low conservation concern. Spanish mackerel are managed under three fishery management plans: the 1983 Coastal Migratory Pelagic Resources Fishery Management Plan of the South Atlantic and Gulf of Mexico Fishery Management Councils, the 1989 Spanish Mackerel Fishery Management Plan – Gulf of Mexico of the Gulf States Marine Fisheries Commission, and the 1990 Spanish Mackerel Fishery Management Plan of the Atlantic States Marine Fisheries Commission. The life history characteristics of king mackerel also make them inherently resilient to fishing pressure. King mackerel stocks in the South Atlantic are not overfished, while king mackerel stocks in the Gulf of Mexico are recovering from an overfished condition. King mackerel stocks are not experiencing overfishing in either region. The primary gears used to harvest king mackerel are handlines; due to finfish bycatch in the handline fishery bycatch rates as a moderate conservation concern. Like gillnets, handlines also have negligible habitat effects. King mackerel are also managed under the 1983 Coastal Migratory Pelagic Resources Fishery Management Plan of the South Atlantic and Gulf of Mexico Fishery Management Councils. Overall, management has generally been successful at maintaining stock productivity for Spanish and king mackerel stocks in the South Atlantic and Gulf of Mexico, and management is considered highly effective. The combination of criteria rankings results in an overall seafood recommendation of "Best Choices" for Spanish and king mackerel.

Table of Ranks

	Conservation Concern			
Sustainability Criteria	Low	Moderate	High	Critical
Inherent Vulnerability	√			
Status of Stocks	√ (Atlantic and Gulf Spanish, Atlantic king)	√ (Gulf king)		
Nature of Bycatch		√		
Habitat Effects	√			
Management Effectiveness	√			

OVERALL SEAFOOD RECOMMENDATION:

Best Choices Good Alternative Avoid

Introduction

Spanish and king mackerel are pelagic, schooling fishes, and are important commercial and recreational fishery species in the South Atlantic and Gulf of Mexico. Both of these mackerel species migrate seasonally along the Atlantic and Gulf of Mexico coasts, moving north in the spring and south in the fall (Beaumariage 1973; Collette and Russo 1984). Spanish mackerel are smaller than king mackerel; the largest Spanish mackerel is reported as 91 centimeters (cm) in length, with a maximum weight of 4.5 kilograms (kg) (Bigelow and Schroeder 1953). The largest length and weight reported for king mackerel are 172.5 cm (Collette and Russo 1984) and 45 kg (Bigelow and Schroeder 1953). Recreational catch has been higher than commercial catch for Atlantic king mackerel since at least 1981/82, for Gulf king mackerel since 1986/87, and for Gulf Spanish mackerel since 1993/94. Commercial catch has been higher than recreational catch for Atlantic Spanish mackerel since 1981/82 (SEFSC 2003; Ortiz 2004a).

Spanish mackerel

Spanish mackerel are found from the Gulf of Maine to Brazil, including the Gulf of Mexico but excluding the Caribbean (Powell 1975). On the east coast of the U.S., Spanish mackerel are found primarily in Florida (Klima 1959). Genetic analysis indicates that Spanish mackerel in the Gulf of Mexico and western Atlantic are a single intermingling stock (Buonaccorsi et al. 2001). Based on catch per unit effort (CPUE) data, Spanish mackerel abundance is higher in the estuarine zone than in offshore and nearshore areas (Palko et al. 1987), and Spanish mackerel in the Gulf of Mexico are landed primarily in state waters (GSMFC 1989). Florida (57%), Alabama (20%), and North Carolina (18%) were the principle sources of U.S. Spanish mackerel landings in 2002 (Figure 1) (NMFS 2004a). The introduction of deepwater gillnets and large-scale boats in 1975 increased landings on the east coast of Florida; previously Spanish mackerel landings in Florida were equally distributed between the western and eastern coasts of Florida (GSMFC 1989). In North Carolina, Spanish mackerel are primarily caught offshore and in Pamlico Sound, and are commonly caught on multi-species trips (Ortiz and Sabo 2003).

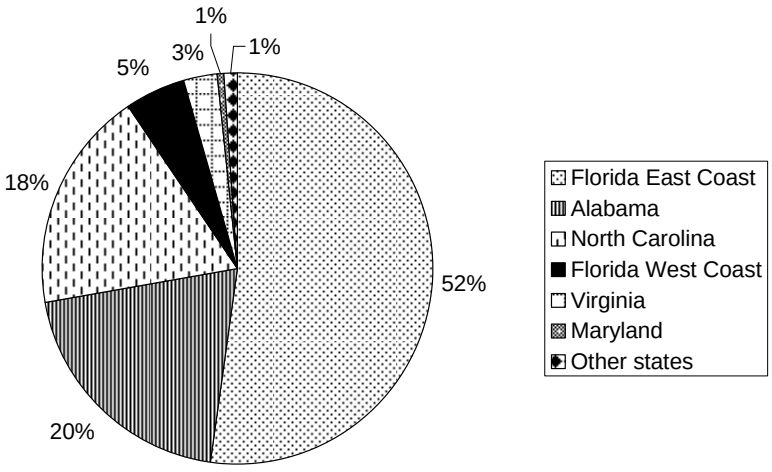


Figure 1. Commercial landings of Spanish mackerel by state, 2002 (NMFS 2004a).

The most common types of commercial gear used to harvest Spanish mackerel are gillnets, cast nets, and handlines. Gillnets are primarily used in federal waters off Florida, and all waters off North Carolina and Alabama. Gillnets are made of monofilament or multifilament webbing, and are hung vertically in the water column to catch pelagic (midwater gillnet) or benthic species (bottom gillnet). Drift gillnets are not anchored to the bottom, and are allowed to drift with the current; runaround gillnets encircle schools of fish, and in North Carolina are also called drop or strike nets (Steve et al. 2001). Total U.S. Spanish mackerel landings exhibited an increasing trend from the 1950s to 1976, when landings peaked at 8,187 metric tons (mt); this peak was followed by a general decline in landings. Average Spanish mackerel landings from 1950 to 2002 were 3,556 mt; the minimum Spanish mackerel landings during this time period were 1,498 mt (Figure 2) (NMFS 2004a). Spanish mackerel are managed by three fishery management plans (FMPs): the 1983 Coastal Migratory Pelagic Resources FMP, the 1989 Spanish Mackerel FMP – Gulf of Mexico, and the 1990 Spanish Mackerel FMP. Spanish mackerel are managed in federal waters by the Gulf of Mexico and South Atlantic Fishery Management Councils, and in state waters of the Atlantic and Gulf of Mexico by the Atlantic States Marine Fisheries Commission (ASMFC) and Gulf States Marine Fisheries Commission (GSMFC), respectively. Current commercial fishery management measures include size limits, total allowable catch (TAC), trip limits, gear restrictions (e.g., mesh size requirements for gillnets), and permit requirements.

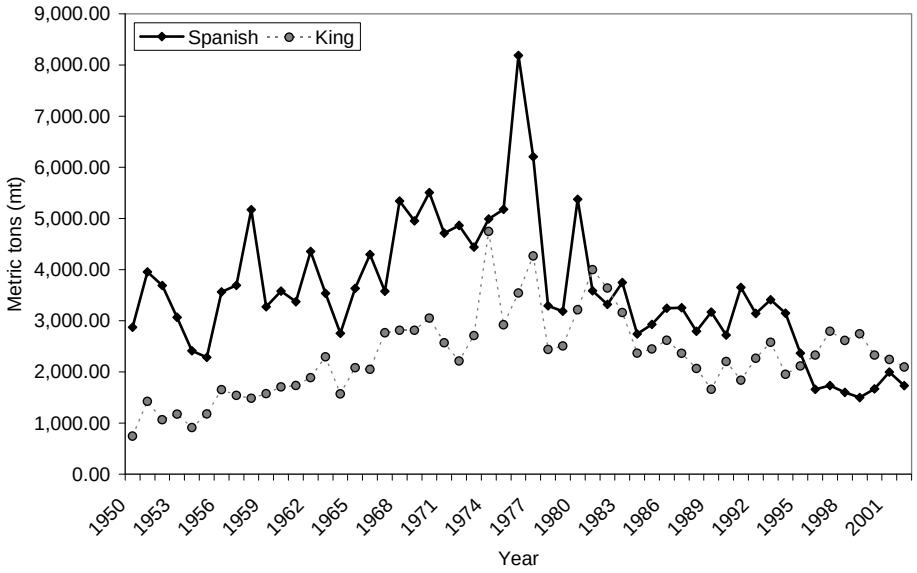


Figure 2. U.S. commercial landings of Spanish and king mackerel, 1950 – 2002 (NMFS 2004a).

King mackerel

King mackerel are found in the western Atlantic from Massachusetts to Brazil, and throughout the Gulf of Mexico (Collette and Russo 1984). U.S. commercial landings of king mackerel[1] are dominated by Florida (61%), Louisiana (19%), and North Carolina (17%) (Figure 3) (NMFS

[1] Landings of king mackerel include landings of cero mackerel, as the landings for these two species are often combined in the NMFS annual commercial landings statistics.

2004a). In the Florida Keys, king mackerel are the primary non-reef fish targeted by sport and commercial fishermen during the winter months; during the 1980s Spanish and king mackerel were the two most important non-reef fish commercial species (Bohnsack et al. 1994). King mackerel commercial landings in the U.S. have exhibited a trend similar to that of Spanish mackerel landings, increasing from 1950 to a peak in 1974, followed by a general decline. Average landings from 1950 to 2002 were 2,322 mt, with a minimum of 743 mt and a peak of 4,748 mt (NMFS 2004). King mackerel are primarily caught using hook and line gear such as handlines and troll lines. Hook and line gear consists of individual lines with baited hooks or lures, which are deployed from a vessel; hook sizes, sinkers, and the weight and type of lines used vary by fishery (Chuenpagdee et al. 2003). In federal waters, king mackerel are managed by the Coastal Migratory Pelagic Resources FMP, which is managed jointly by the GMFMC and SAFMC. Commercial fishery management measures include size limits, TAC, trip limits, and permit requirements. Management in the Gulf of Mexico also includes seasons, gear and area specific quota allocations (with closure upon reaching the quota), and gear specific area restrictions.

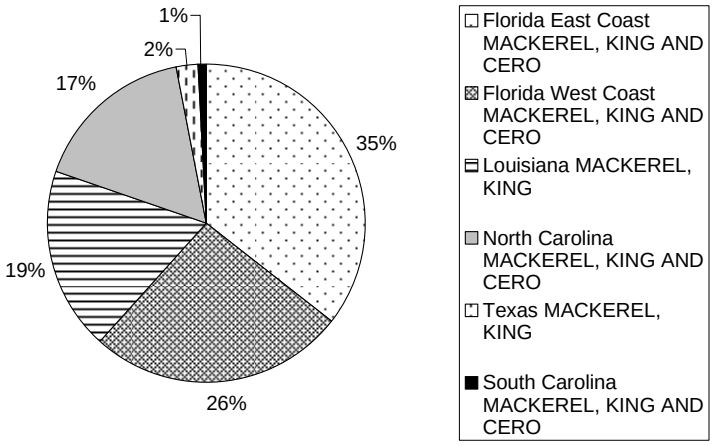


Figure 3. Commercial landings of king and cero mackerel by state, 2002 (NMFS 2004a).

Scope of the analysis and the ensuing recommendation:
There are five mackerel species landed in the U.S.: Atlantic, chub, frigate, cero, king, and Spanish (NMFS 2004a). Although Spanish and king mackerel contributed 6% and 7%, respectively, to the total U.S. mackerel landings in 2002 (NMFS 2004a), they are the most commonly caught species in the southeast region of the U.S. This seafood report encompasses the commercial fishery for Spanish and king mackerel in the South Atlantic and Gulf of Mexico.

Availability of Science

The following data are collected by the Southeast Fisheries Science Center (SEFSC), or estimated using modeling approaches: length and weight at age; size frequencies; fishing mortality and migration; age and CPUE data by area, season, fishery, and gear; and mackerel

bycatch in shrimp trawls (Ansley et al. 2003). Future research needs identified by the Mackerel Stock Assessment Panel include a more thorough examination of king mackerel mixing rates in the Atlantic, eastern Gulf of Mexico, and western Gulf of Mexico; a re-examination of growth information using more recent data; an estimation of age at length for the four migratory groups; and consideration of updated data on mackerel bycatch in shrimp trawls to include in future assessments (MSAP 2003). Although there are adequate data on the life history of Spanish and king mackerel, it is becoming outdated due to a lack of data on age structure sampling and size and weight information from fishery independent sources. Such inadequacies create a lack of viable growth models, therefore introducing uncertainty when estimating fecundity and maturity at size and age. Stock assessments for Atlantic and Gulf Spanish mackerel were conducted in 2003, and Atlantic and Gulf king mackerel were conducted in 2004. There are limited data on bycatch associated with the mackerel fisheries, but sufficient information exists concerning the habitat effects of gear used to harvest mackerels. Management information such as FMPs and FMP amendments are available as grey literature.

Market Availability

Common and market names:
Common names for Spanish mackerel include sierra (MRFSS 2002) and Spaniard (SAFMC 2004). Common names for king mackerel include cavalla, king, kingfish (MRFSS 2002), smoker, slab, and hog (SKA 2004). When used for sushi or sashimi, Spanish mackerel is commonly sold as *sawara*. It is also incorrectly sold as *aji*, which is the true sushi name for horse mackerel.

Seasonal availability:
Spanish and king mackerel are available year-round. King mackerel are caught year-round off South Florida and Louisiana (Trent et al. 1983).

Product forms:
Mackerel is generally consumed fresh, frozen, or smoked (Collette and Russo 1984).

Import and export sources and statistics:
Mexican landings of Gulf Spanish mackerel increased six-fold from 1940 to 1949, and were consistently higher than Florida landings during 1968 – 1987 (GSMFC 1989). In 2003, 41 countries imported mackerels to the U.S. (NMFS 2004b). The National Marine Fisheries Service (NMFS) foreign trade database does not differentiate between the specific species of mackerel that are imported and exported to and from the United States. Chile, Norway, and China (Tapei) were the primary importers of all mackerel species to the U.S. in 2003, contributing 62% of the total 22,000 mt of imported mackerel (NMFS 2004b). However, these figures do not include imports of Spanish and king mackerel, as their range does not extend to these areas, unless they have been imported, processed, and re-exported. Total imports of mackerels from Mexico in 2002 were 484 mt; these numbers rose to 1,236 mt in 2003 (NMFS 2004b). In 2002, the U.S. exported 14,809 mt of mackerels, primarily to Nigeria, Japan, and Canada (NMFS 2004b). In 2003, that number increased to 25,333 mt (NMFS 2004b). The relative contribution of imported

Spanish and king mackerel to the U.S. market is unknown, as species-specific import data are not collected.

Analysis of Seafood Watch® Criteria

Criterion 1: Inherent Vulnerability to Fishing Pressure

Life history characteristics of Spanish and king mackerel differ from each other, and impact their inherent vulnerability to fishing pressure (Table 1).

Spanish mackerel

Temperature and salinity limit Spanish mackerel distribution, as they prefer 21° – 27° C waters and salinities up to 32 ppt (Godcharles and Murphy 1986). Female Spanish mackerel exhibit faster growth rates than males (Powell 1975), and also live longer than males (Fable et al. 1987). The maximum recorded size for Spanish mackerel is 91 cm fork length (FL) (Bigelow and Schroeder 1953). Spanish mackerel growth rates are similar in the South Atlantic and Gulf of Mexico, while larval and juvenile king mackerel growth rates are highest in the Mississippi River plume (DeVries et al. 1990).

Gulf Spanish mackerel spawn from May through September (Finucane and Collins 1986); Atlantic Spanish mackerel spawn from May through August (Schmidt et al. 1993). Spanish mackerel have a maximum age of 11 years (Schmidt et al. 1993), although most of the fish in the population are ages 1 – 3 (Powell 1975). Female Atlantic Spanish mackerel become sexually mature later and at a larger size than males (Schmidt et al. 1993). Most female Spanish mackerel mature at age 1 and at lengths greater than 36 cm FL (Schmidt et al. 1993). The minimum legal length for Spanish mackerel is set at 12 inches (in) (30.5 cm) or 14 in (35.6 cm) depending on the state. It is therefore likely that immature Spanish mackerel are being harvested. Fecundity for Spanish mackerel ranges from 100,000 eggs to approximately 2 million eggs (Finucane and Collins 1986). Spanish mackerel do not exhibit any special behaviors that increase their ease of capture, and there is no evidence that population variability is driven by physical environmental change.

King mackerel

Gulf king mackerel exhibit a fast growth rate during their first three years, which decreases as they age (Manooch et al. 1987). The dominant age groups of king mackerel caught in the Gulf of Mexico from 1980 – 1985 were ages 1 – 3; fish aged 4 – 7 years were also common but those older than age 7 were rare (Manooch et al. 1987). Female king mackerel have been shown to reach a larger length-at-age than males (Manooch et al. 1987), and dominate the catch in most months off Louisiana (Trent et al. 1987a), as well as in other southeast areas (Trent et al. 1983). King mackerel in the Atlantic, eastern Gulf of Mexico, and western Gulf of Mexico exhibit differences in growth, supporting the hypothesis of three migratory stocks of king mackerel (DeVries and Grimes 1997). At every age in each of the three regions, female king mackerel grew faster and larger than males (DeVries and Grimes 1997). Growth was highest in the eastern Gulf (Johnson et al. 1983), intermediate in the western Gulf, and lowest in the Atlantic (DeVries and Grimes 1997). Sutter et al. (1991) also found that Atlantic king mackerel exhibit a larger maximum size and a slower relative growth rate than Gulf king mackerel. Females also

composed a larger proportion of the recreational fishery compared to the commercial fishery (Trent et al. 1987a). The average size of king mackerel is 70 cm, and the maximum recorded size is 172.5 cm FL (Collette and Russo 1984).
Atlantic and Gulf king mackerel are serial spawners, releasing batches of eggs serially throughout the spawning season (Finucane et al. 1986). Atlantic king mackerel spawn from January to September (Grimes et al. 1990), while Gulf king mackerel spawn from May to October (Finucane et al. 1986; DeVries 2003). Atlantic king mackerel are sexually mature at ages 3 – 4 (Beaumariage 1973; Powell 1975). King mackerel are highly fecund, with egg production ranging from 69,000 eggs to 12.2 million eggs (Finucane et al. 1986).

Table 1. Life history characteristics of Spanish and king mackerel.

Species	Intrinsic Rate of Increase (r)	Growth Rate	Max Size	Age at Maturity	Maximum Age	Fecundity	Species Range	Special Behaviors	Population Variability	Sources
Spanish mackerel	Unknown	**SA:** vBgf: L_∞ = 76.0 cm, k = 0.18	91 cm FL	0 (males); 0-1 yr (females)	6 yrs (male), 11 yrs (female)	100 k – 2.0 mil eggs	Western Atlantic from Gulf of ME to Brazil (excluding Caribbean); Gulf of Mexico	None	Not driven by physical env. change	Bigelow and Schroeder 1953; Powell 1975; Finucane and Collins 1986; Schmidt et al. 1993
King mackerel	Unknown	**SA:** vBgf[2]: L_∞ = 118 cm, k = 0.17 **GOM:** vBgf: L_∞ = 130 cm, k = 0.14	172.5 cm FL	3-4 yrs	26 yrs (SA); 22 yrs (eastern GOM); 24 yrs (western GOM)	69 k – 12.2 mil eggs	Western Atlantic from MA to Brazil; Gulf of Mexico	None	Not driven by physical env. change	Beaumariage 1973; Collete and Russo 1984; Finucane et al. 1986; DeVries and Grimes 1997; Brooks and Ortiz 2004a

INHERENT VULNERABILITY RANK

The intrinsic rates of increase for Spanish and king mackerel are unknown. Spanish and king mackerel are highly fecund, and both species reach sexual maturity at a young age (< 5 yrs). Spanish mackerel have a low maximum age, while king mackerel are moderately long lived. Both species have a limited range, being found only in the western Atlantic and Gulf of Mexico. Spanish and king mackerel do not exhibit any special behaviors that increase ease of capture, and there is no evidence of high population variability driven by physical environmental change. Both Spanish and king mackerel are considered inherently resilient to fishing pressure.

[2] vBgf = a commonly used growth function in fisheries science to determine length as a function of age. $L\infty$ is maximum length, and k is body growth coefficient.

Inherent Vulnerability Rank: **Resilient** Neutral Vulnerable

Criterion 2: Status of Wild Stocks

Stock status varies by species and region (Table 2). For the four mackerel groups discussed in this analysis (Atlantic and Gulf Spanish mackerel, and Atlantic and Gulf king mackerel), overfishing occurs when the fishing mortality rate (F) is higher than the F corresponding to a 30% static spawning potential ratio (SPR), or $F_{30\%SPR}$ (NMFS 2003). This value is the maximum fishing mortality threshold (MFMT). For all four mackerel groups, a stock is considered overfished when the stock size is less than the minimum stock size threshold (MSST); the MSST is $(1.0 - M)*B_{MSY}$ (i.e., the spawning stock biomass that can support Maximum Sustainable Yield, MSY, but reduced by the natural mortality rate, M) (MSAP 2003; NMFS 2003). For Atlantic king mackerel, the MSST is 85% of spawning stock biomass that will support MSY; for Gulf king mackerel the MSST is 80% (SEDAR 2004). The determination of whether or not a stock is overfished, or overfishing is occurring, depends on the acceptable level of risk chosen by an individual Fishery Management Council (e.g., the GMFMC has adopted a 50% probability that a given stock biomass is less than MSST as an acceptable risk level) (MSAP 2003).

Table 2. Stock status of Spanish and king mackerel in the Gulf of Mexico and South Atlantic.

Species	Classification Status	B/B_{MSY}	Occurrence of Overfishing	F/F_{MSY}	Abundance Trends/CPUE	Age/Size/Sex Distribution	Degree of Uncertainty in Stock Status	Sources
Atlantic Spanish mackerel	Not overfished	1.78	Not occurring	0.58	Increasing trend	Unknown	Low	NMFS 2003; SEDAR 2004
Gulf Spanish mackerel	Not overfished	1.34	Not occurring	0.53	Stable trend	Unknown	Low	NMFS 2003; SEDAR 2004
Atlantic king mackerel	Not overfished	1.22	Not occurring	0.52	Stable trend	Unknown	Moderate	NMFS 2003; SEDAR 2004
Gulf king mackerel	Not overfished	0.95	Not occurring	0.82	Increasing trend	Unknown	Moderate	NMFS 2003; SEDAR 2004

Mackerel bycatch

Another factor affecting the stock status of Spanish and king mackerel is bycatch of juvenile mackerel in the shrimp trawl fishery. Mackerels taken as bycatch in shrimp trawls are predominantly juvenile fishes, and are more abundant in tows made in waters less than 9 m in depth (Collins and Wenner 1988). Bycatch estimates indicate approximately 442,000 king mackerel (age-0) were taken in the U.S. Gulf of Mexico shrimp trawl fishery in 2000 and 2002 (Figure 4) (Ortiz 2004a); these estimates were not updated prior to the stock assessment in 2004. Using the general linear model, Spanish mackerel bycatch in shrimp trawls has been estimated at

3.2 million fish from 1972 – 1995; using a delta lognormal model, bycatch of Spanish mackerel has been estimated at 6.5 million fish for the same time period (Figure 5) (Ortiz et al. 2000). In addition, Poffenberger (2003) estimated that an average 27,658 king mackerel were discarded annually (1998 – 2002) in the Gulf of Mexico and South Atlantic gillnet, handline, and troll fisheries.

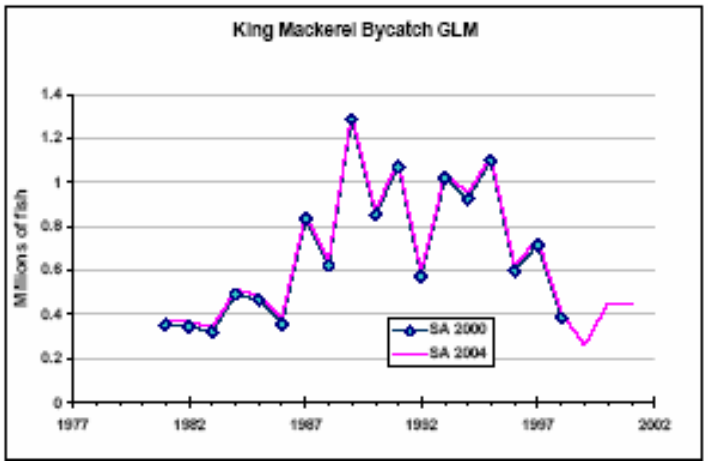


Figure 4. Estimates of king mackerel bycatch from the U.S. Gulf of Mexico shrimp trawl fishery for the 2000 and 2004 assessments, using the general linear model (GLM) (Figure from Ortiz 2004a).

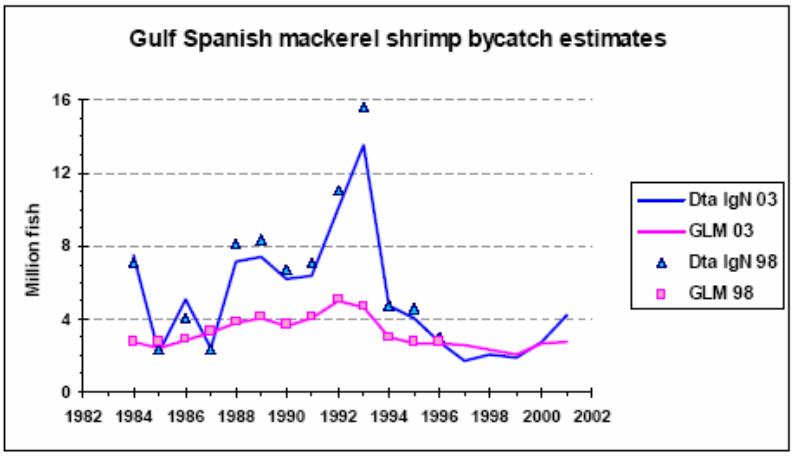


Figure 5. Comparison of 1998 and 2003 estimates of Spanish mackerel bycatch in the U.S. Gulf of Mexico shrimp trawl fishery for both the general linear (base) and delta lognormal models (Figure from SEFSC 2003).

Atlantic Spanish mackerel

Atlantic Spanish mackerel are not overfished, and overfishing is not occurring (NMFS 2003). Estimated recruitment was variable during the 1984 – 1998 period (MSAP 2003). The median estimate of F/F_{MSY} was 0.58 based on projected landings for the 2002/03 fishing year, and the median estimate of B_{2003}/B_{MSY} was 1.78 (MSAP 2003). Since 1995, estimated F has been below F_{MSY}, and estimated stock abundance has exhibited an increasing trend (MSAP 2003). Fishery dependent data are the primary sources of abundance trends (Ansley et al. 2003). CPUE indices used in the Atlantic Spanish mackerel assessment include four fishery dependent indices: the

Florida Fish and Wildlife Conservation Commission Marine Fisheries Trip Ticket Program (FLWC); the Marine Recreational Fisheries Statistics Survey (MRFSS); the North Carolina Division of Marine Fisheries Trip Ticket Program (NCDMF); and the NMFS Beaufort Laboratory Headboat Survey (Headboat). Two fishery independent indices were also used: the NCDMF Pamlico Sound Survey, and the Southeast Area Monitoring and Assessment Program (SEAMAP) (SEFSC 2003). Commercial CPUE data from North Carolina show generally increasing long term and short-term trends (Ortiz and Sabo 2003). Long and short-term trends in population abundance are variable as measured by fishery independent means (i.e., SEAMAP data), and the long and short term trends in population abundance as measured by commercial fishery CPUE data are up (Figure 6) (SEFSC 2003). Model estimates indicate that stock size is increasing (Figure 7) (SEFSC 2003). It is unknown whether the current age/size/sex distribution is normally distributed relative to the natural condition of the stock. There is a low degree of uncertainty in the status of the Atlantic Spanish mackerel stock.

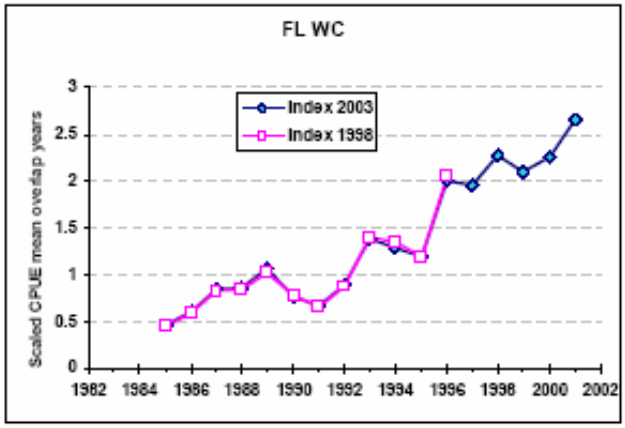


Figure 6. Comparison of standardized CPUE data from FLWC for Atlantic Spanish mackerel used in 1998 stock assessments and the 2003 analysis (Figure from SEFSC 2003).

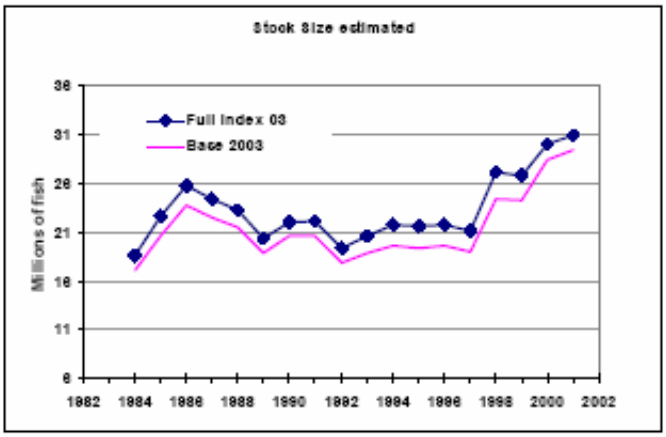


Figure 7. Estimates of Atlantic Spanish mackerel stock size by age from the Base and Full index models (Figure from SEFSC 2003).

Gulf Spanish mackerel

Gulf Spanish mackerel are not overfished, and overfishing is not occurring (NMFS 2003). In 2002/03 the median estimate of F/F_{MSY} was 0.53, and the median estimate of B_{2003}/B_{MSY} was 1.34 (MSAP 2003). The long and short-term fishery independent abundance trends are variable. CPUE indices used in the Gulf Spanish mackerel assessment include FLWC, MRFSS, Headboat, SEAMAP, Shrimp Bycatch Index, and Texas Parks and Wildlife Recreational Angler Creel Survey (SEFSC 2003). Long term, CPUE-based estimates are variable, while short-term CPUE-based abundance estimates exhibit an increasing trend. Model estimates of abundance exhibit a variable long-term trend and an increasing short-term trend (Figure 8) (MSAP 2003). The age/size/sex distribution relative to the natural condition of the stock is unknown. There is a low degree of uncertainty associated with the status of the Gulf Spanish mackerel stock.

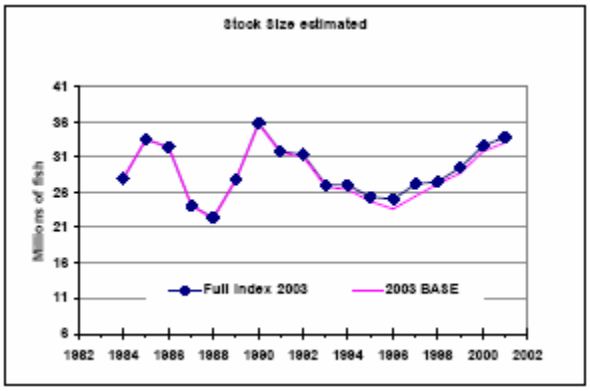


Figure 8. Estimated Gulf Spanish mackerel abundance (Figure from SEFSC 2003).

Atlantic king mackerel

The full assessment conducted in 2003 found that estimated recruitment of Atlantic king mackerel generally increased from 1992 to 1999 (MSAP 2003). The Atlantic king mackerel stock is not overfished, and overfishing is not occurring. The median estimate of F/F_{MSY} was 0.56 for fishing year 2002/03, and the median estimate of B_{2003}/B_{MSY} was 1.22 (MSAP 2003). CPUE indices used in the Atlantic king mackerel stock assessment include FLWC, MRFSS, NCDMF, Headboat, and SEAMAP (SEFSC 2003). Commercial CPUE data for Atlantic king mackerel in North Carolina show a slightly decreasing trend since 1993, with a flat short term trend (Ortiz and Sabo 2003). Recreational CPUE data for the Atlantic king mackerel stock show variable long and short-term trends, with a generally flat trend since 1980 (Ortiz 2003). Although estimated stock size has increased since the mid-1990s, estimates of MSY declined from 10.4 million lbs for the 1998 assessment to 5.9 million lbs for 2003 assessment (MSAP 2003). Long-term fishery independent abundance trends are flat, and long and short-term CPUE based abundance trends are variable. Overall abundance trends estimated from the stock assessment model are flat. In 2003, stock size estimates that included age-0 recruits indicated a downward short term trend (SEFSC 2003); however, due to uncertainty in the data, the 2004 model run did not include the age-0 recruits (Ortiz 2004b). The long and short-term trends based on these data are stable (Figure 9). Recently, recruitment has exhibited a downward trend. The age/size/sex distribution relative to the natural condition of the stock is unknown. The proportion of Atlantic king mackerel harvested in ages 0-3 has increased since the 1980s, but has

remained relatively stable since the 1990s (GKMAR 2004). Meanwhile the proportion of Atlantic king mackerel harvested in ages 8-11+ has declined (GKMAR 2004). This age group contributed about 40% of the harvest until the mid-1980s, and about 20% throughout the 1990s (GKMAR 2004). There is a moderate level of uncertainty associated with the status of the Atlantic king mackerel stock.

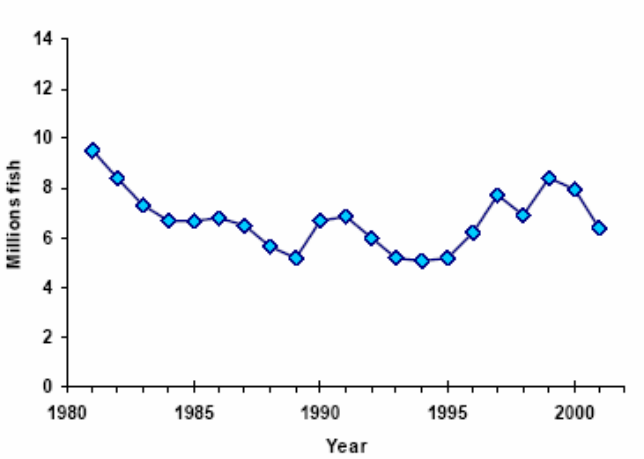


Figure 9. Estimated Atlantic king mackerel stock abundance from the 2003 base model, which does not include age-0 recruits due to uncertainty in the estimates (Figure from Ortiz 2004b).

Gulf king mackerel

The 2004 stock assessment concluded that Gulf king mackerel are not overfished, but the stock has not rebuilt to B_{MSY} (SEDAR 2004)[3]. Until the recent stock assessment, Gulf king mackerel had been overfished for more than 10 years (DeVries 2003). For fishing year 2002/03, the median estimate of F/F_{MSY} was 0.82 for Gulf king mackerel, and the median estimate of B_{2003}/B_{MSY} was 0.95 (SEDAR 2004). Recreational CPUE data for Gulf king mackerel show variable long and short-term trends, although the charter boat CPUE data for Florida show an increasing trend (Ortiz 2004a). Gulf king mackerel larval abundance is highly correlated with spawning stock size; from 1982 – 1995 the occurrence and abundance of Gulf king mackerel increased (Figure 10) (Gledhill and Lyczkowski-Shultz 2000). Spawning levels off of Texas were reduced in the late 1980s, compared to the 1970s, possibly due to fishing pressure (Grimes et al. 1990). Long and short-term fishery independent abundance trends are up; long term CPUE based abundance trends are variable, while short-term CPUE trends are down (Ortiz 2004a). Model estimates of stock size show increasing long and short-term trends (Figure 11) (Ortiz 2004a). The age/size/sex distribution relative to the natural condition of the stock is unknown. The proportion of Gulf king mackerel harvested in ages 0-3 has increased since the 1980s, but has remained relatively stable since the 1990s (GKMAR 2004). In 1981, fish ages 0-3 contributed less than 20% of the Gulf king mackerel harvest, and approximately 50% of the harvest in 2001 (GKMAR 2004). Meanwhile, the proportion of Gulf king mackerel harvested in ages 4-7 has declined in a similar pattern over the same time period, ranging from above 80% in

[3] The 2004 stock assessment was accepted by the Scientific and Statistical Committee (SSC) of the GMFMC, but it was rejected by the SSC of the SAFMC.

1981 to approximately 40% in 2001 (GKMAR 2004). There is a moderate degree of uncertainty associated with the status of the Gulf king mackerel stock.

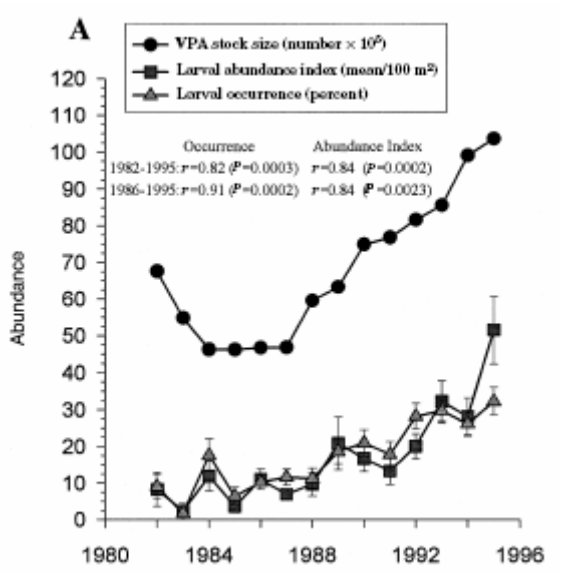


Figure 10. Gulf king mackerel adult spawning size estimated by VPA, survey larval index of abundance, and survey larval frequency of occurrence (Figure from Gledhill and Lyczkowski-Shultz 2000).

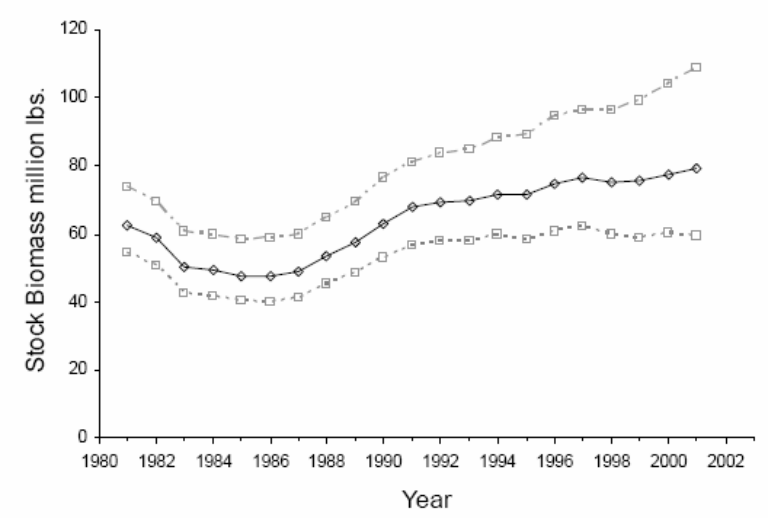


Figure 11. Estimated Gulf king mackerel stock biomass from 1981 through 2001. Gray lines represent the 80% pseudo-confidence interval about the median biomass estimates (Figure from GKMAR 2004).

STATUS OF WILD STOCKS RANK

Spanish mackerel are not overfished, and overfishing is not occurring in either the South Atlantic or the Gulf of Mexico. These stocks are considered healthy due to their increasing or stable trends in abundance, and there is no evidence that the age/size/sex distribution of either of these stocks is skewed relative to the natural condition of the stocks. Atlantic king mackerel are not overfished and overfishing is not occurring. This stock is considered healthy due to its stable trends in abundance. In the Gulf of Mexico, king mackerel are not overfished, and overfishing is not occurring. However, this stock is considered weak, as it has just recently recovered from an overfished condition, and the stock has not rebuilt to B_{MSY}.

Status of the Stocks Rank:

Healthy

Atlantic and Gulf Spanish, and Atlantic king mackerel

Weak

Gulf king mackerel

Poor

Critical

Criterion 3: Nature and Extent of Bycatch

Seafood Watch® defines bycatch as catch that is landed but subsequently discarded; it does not include incidental take that is utilized, and managed as bycatch. The primary gears used to harvest Spanish mackerel in 2002 were gillnets (57%), cast nets (16%), and handlines (12%) (Figure 12) (NMFS 2004a). The primary gears used to harvest king mackerel in 2002 were handlines (59%), troll lines (14%), electric or hydraulic reels (8%), and runaround gillnets (8%) (Figure 13) (NMFS 2004a). As cast nets are generally used in the recreational fishery or to capture baitfish, cast nets are not analyzed in this report. Marine mammals and finfish are the primary bycatch concerns associated with the Spanish and king mackerel fisheries, respectively (Table 3).

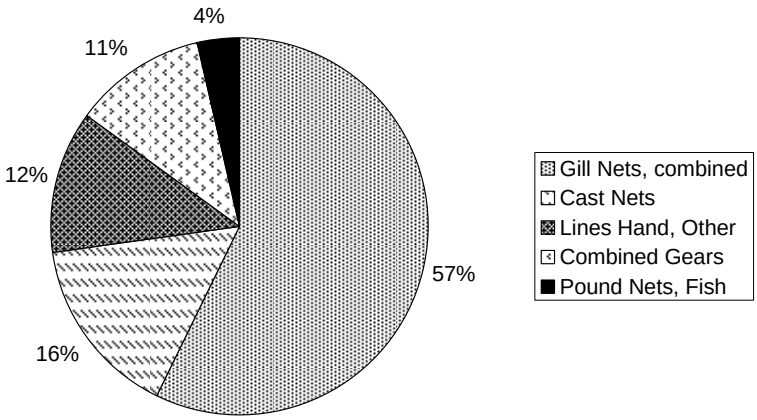


Figure 12. Spanish mackerel commercial landings by gear type, 2002 (NMFS 2004).

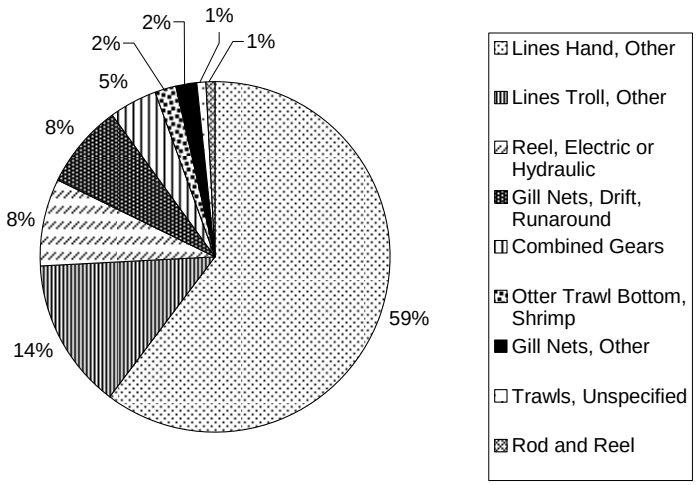


Figure 13. King mackerel commercial landings by gear type, 2002 (NMFS 2004).

Table 3. Bycatch characteristics of the Spanish and king mackerel fisheries.

Gear	Composition of Bycatch	Population Consequences of Bycatch	Bycatch/Target Species Ratio	Trend in Quality & Quantity of Bycatch	Ecosystem Effects	Sources
Gillnets	Intermediate diversity of species; may include marine mammals	Unknown	Moderate (71% nontarget species, 24% target species)	Unknown	None	Palka and Rossman 2001; Read et al. 2003; Poffenberger 2004
Hook and line gear	High diversity of species	Unknown	Unknown	Unknown	None	Poffenberger 2004

Hook and line gear

Supplemental discard data in the handline, troll, gillnet, and bottom longline fisheries in the Gulf of Mexico and the South Atlantic were collected by the Southeast Fisheries Science Center (SEFSC) from 2001 to 2003 (Poffenberger 2004). Handlines had a high diversity of bycatch, as well as a high number of animals discarded. In the South Atlantic, 114 different species were discarded from 298 vessels during the survey period (Poffenberger 2004). The three most common species discarded in the South Atlantic handline fishery were red porgy, vermillion snapper, and yellowtail snapper (Poffenberger 2004). Vermillion snapper is experiencing overfishing, and it is unknown whether the stock is overfished (NMFS 2004c). In the Gulf of Mexico, 79 different species were discarded from 338 vessels during the survey period (Poffenberger 2004). The three most common species discarded in the Gulf of Mexico handline fishery were red grouper, red snapper, and gag grouper (Poffenberger 2004). Both red grouper and red snapper are overfished, and overfishing is occurring (NMFS 2004c). It is unknown whether the quantity of bycatch in the mackerel fishery is negatively influencing the species population level. The condition of the discarded species varied with species and location (Table 4). Although unwanted catch can be returned to the water relatively quickly with the gear types used, the survival of discarded fish may be reduced as a result of damage from hooking and handling (Chuenpagdee et al. 2003). As defined by NMFS (undated), hook and line fisheries are thought to have a "high potential" for fish bycatch, a "moderate potential" for sea turtle and sea bird bycatch, and a "low potential" for marine mammal bycatch. The quantity of bycatch relative to the quantity of the targeted species is unknown. There is no evidence that the ecosystem has been altered as a result of the continued removal of the bycatch species, although no studies have shown that these removals are sustainable, and assessments have shown that some bycatch species are in poor condition. The trend in the quantity and diversity of bycatch species is also unknown.

Table 4. Condition of discards from the handline, bottom longline, troll, traps and pots, and gillnet fisheries for reef fish, snapper-grouper, Spanish and king mackerel, and shark fisheries in the southeastern U.S. (sorted by discard prevalence in the South Atlantic and Gulf of Mexico handline fisheries). The percentage of discards that were dead or alive was recorded (Table from Poffenberger 2004).

Species Name	All discards dead (%)	Majority dead (%)	All discards alive (%)	Majority alive (%)	Kept not sold (%)	Unknown (%)	Unreported (%)
Red porgy	0.7	24.8	28.5	43.5	2.4	0.0	0.1
Vermillion snapper	1.3	14.5	35.7	47.0	1.5	0.0	0.0
Yellowtail snapper	4.7	1.9	53.9	35.5	2.9	0.6	0.6
Red grouper	0.7	5.8	38.6	51.0	0.1	3.9	0.0
Red snapper	9.6	33.2	8.1	33.7	0.0	15.5	0.0
Gag grouper	0.2	0.3	70.1	23.5	0.3	5.6	0.0
Menhaden	2.0	84.0	0.0	13.0	0.0	1.0	0.0

Gillnets

Midwater gillnets have been rated by Chuenpagdee et al. (2003) as having a "high impact" on finfish and shark bycatch, and a "very high impact" on marine mammal, seabird, and sea turtle bycatch. The North Carolina coastal gillnet fishery has been categorized as having a "moderate potential" for fish bycatch, and a "high potential" for marine mammal and sea turtle bycatch (NMFS undated). The SEFSC data show that gillnet and trolling discards in the South Atlantic and Gulf of Mexico were generally relatively low, although reported discards in the South Atlantic gillnet fishery included a large number of menhaden and several species of sharks (Poffenberger 2004).

In the Mid-Atlantic, bycatch rates of bottlenose dolphins are highest for the large mesh gillnet fisheries (≥ 7 in), intermediate for the medium mesh gillnet fisheries (5 – 7 in), and lowest for the small mesh gillnet fisheries (≤ 5 in) (Palka and Rossman 2001). Spanish mackerel were one of the most commonly landed species in the small mesh gillnet fishery from 1996 – 2000 in northern North Carolina, while king mackerel were one of the most commonly landed species in the medium mesh gillnet fishery in North Carolina state waters (Palka and Rossman 2001). However, the east coast of Florida contributed the largest proportion of both Spanish and king mackerel to U.S. landings, and gillnets are not permitted in Florida state waters. In the 1970s and 1980s, drift gillnetters targeting sharks in the winter months also targeted king mackerel from April to September to compensate for reduced catches in the winter fishery (Trent et al. 1997). In the shark drift gillnet fishery off Georgia and the east coast of Florida, king mackerel was the primary finfish bycatch species, although bycatch was only 8.4% of the total catch (Trent et al. 1997). A recent study conducted in North Carolina found that although bottlenose dolphins encountered (i.e., a dolphin approached within 500 m of the net) and interacted with (i.e., a dolphin came within one body length of the net) Spanish mackerel gillnets, no dolphins became entangled in the nets (Read et al. 2003). The annual estimate of bottlenose dolphins taken as bycatch in the Spanish mackerel gillnet fishery is 14 animals (Palka and Rossman 2001). From the 30 gillnets set for Spanish mackerel that were observed by Read et al. (2003), the catch comprised Spanish mackerel (24% by number), small sharks (24%), bluefish (19%), Atlantic bonito (18%), and harvestfish (10%). Of the total catch from gillnets targeting Spanish mackerel, 71% of the species caught were nontarget species (Read et al. 2003). It is unknown what percentage of these nontarget species was discarded.

Gillnet bycatch includes a moderate diversity of species. Although it does include marine mammal bycatch such as bottlenose dolphins, it is thought that interactions are common but entanglement is rare. Bottlenose dolphins are not listed as threatened or endangered under the Endangered Species Act, but the western North Atlantic coastal stock is listed as depleted under the Marine Mammal Protection Act (NMFS 2002). The trend in quantity and diversity of bycatch is unknown, and there is no evidence that the ecosystem has been altered in response to the continued removal of the bycatch species.

NATURE OF BYCATCH RANK

Gillnets and handlines are the most common gear types used to harvest Spanish and king mackerel, respectively. The small mesh gillnets used to target Spanish mackerel may contribute to marine mammal bycatch, but the rate of bycatch is much lower than for the medium and large

mesh gillnet fisheries, and is not thought to have an impact on population levels of marine mammals (e.g., bottlenose dolphins). Handline discards in the South Atlantic and Gulf of Mexico include a high diversity of species. The consequences and trends in bycatch composition and quantity are unknown, and the quantity of bycatch relative to the quantity of targeted landings is also unknown. Gillnet data indicate that bycatch of similar trophic level species composed 47% of the total catch. There is no evidence suggesting that the ecosystem will be altered as a result of the continued removal of the bycatch species. Based on the preceding criteria, bycatch in the Spanish and king mackerel fisheries rates as a moderate conservation concern.

Nature of Bycatch Rank:

Low | **Moderate** | High | Critical

Criterion 4: Effect of Fishing Practices on Habitats and Ecosystems

Handlines and midwater gillnets have been rated as having a "very low impact" on physical and biological marine habitat (Table 5) by Chuenpagdee et al. (2003). The most common gillnets used to catch mackerel are drift or runaround gillnets, which have little to no contact with the ocean bottom. Gillnets are thought to have a negligible effect on habitat in the southeastern U.S. (Barnette 2001). Gillnets affect a moderate geographic area, and cause minimal damage to the physical and biogenic marine habitats. Potential habitat effects of hook and line gear, such as handlines and troll lines, include entanglement of lost gear, and damage and habitat loss of sponge and coral cover from sinkers and fishing weights (Barnette 1999). Hook and line gear have a limited geographic extent, and cause little damage to the physical and biogenic habitat. Cast nets are often used in shallow waters such as estuaries, or in offshore federal waters to catch baitfish (Barnette 2001). Possible bottom effects associated with cast nets include entanglement in sponges and other growth associated with rough bottom habitat (Barnette 2001), and some abrasion of submerged aquatic vegetation (Barnette 1999). To date, there is no evidence that the removal of Spanish and king mackerel will substantially disrupt the food web, or cause ecosystem state changes.

Table 5. Habitat effects of gear used to harvest Spanish and king mackerel.

Gear Type	Effect of Fishing Gear on Habitats	Habitat Resilience to Disturbance	Geographic Extent of Fishery Effects	Evidence of Food Web Disruption	Evidence of Ecosystem Changes	Sources
Gillnet	Minimal damage	High	Moderate area	None	None	Barnette 2001
Hook and line gear	Minimal damage	High	Limited area	None	None	Barnette 1999; Barnette 2001

EFFECT OF FISHING PRACTICES RANK

Gillnets used to harvest Spanish and king mackerel have a moderate geographic extent, but result in minimal damage to habitat, as they have little to no contact with the ocean bottom. Hook and line gear have a limited geographic extent, and cause minimal damage to the surrounding ecosystem. The physical and biogenic habitat is considered highly resilient to disturbance by midwater gillnets and hook and line gear. There is no evidence suggesting that the removal of the target species has or will likely substantially disrupt the food web, or that the fishing methods used have caused ecosystem state changes. The effect of Spanish and king mackerel fishing practices on habitats and ecosystems are considered benign, and thus rates as a low conservation concern.

Effect of Fishing Practices Rank: **Benign** Moderate Severe

Criterion 5: Effectiveness of the Management Regime

Spanish mackerel

Spanish mackerel are managed by three different FMPs. The 1983 Coastal Migratory Pelagic Resources FMP, developed by the GMFMC and SAFMC, manages Spanish mackerel in South Atlantic and Gulf of Mexico federal waters. Federal commercial regulations for Spanish and king mackerel in the Gulf of Mexico vary by location (Table 6). The 1990 Spanish Mackerel FMP, developed by the ASMFC, manages Spanish mackerel in state waters from south of the New York/Connecticut border through the east coast of Florida. The 1989 Spanish Mackerel FMP – Gulf of Mexico, developed by the GSMFC, manages Spanish mackerel in the state waters of the Gulf of Mexico. Spanish mackerel in the Atlantic are managed on the basis of the annual recommendations of the Mackerel Stock Assessment Panel (MSAP), which is appointed by the GMFMC and SAFMC. State management agencies involved in fisheries management of Gulf Spanish mackerel under the Spanish Mackerel FMP include the Texas Parks and Wildlife Department, the Louisiana Department of Wildlife and Fisheries, the Mississippi Department of Marine Resources, the Alabama Marine Resources Division, and the Florida Fish and Wildlife Conservation Commission (GSMFC 1989). Management measures to control effort have been implemented in North Carolina, Virginia, Maryland, and New York. State management agencies have been successful in complying with the recommendations of the Spanish Mackerel FMP (Table 7). Management measures include size limits, trip limits, gear restrictions, and permit requirements. Although the commercial fishery along the Atlantic coast for Spanish mackerel has been primarily in state waters, the 1995 Florida net ban shifted effort from Florida state waters to federal waters (Ansley et al. 2003).

The Mackerel Stock Assessment Panel (MSAP) recommended a 6.7 million lb Allowable Biological Catch (ABC) for Atlantic Spanish mackerel (MSAP 2003); however the SAFMC maintained the TAC for Atlantic Spanish mackerel at the 7.04 million lbs level established for the 1999/2000 fishing year (Figure 14) (Ansley et al. 2003). The current TAC is within the confidence interval of estimated ABC levels provided by the MSAP. The median estimate of ABC for Atlantic Spanish mackerel exceeded the median estimate of maximum sustainable yield (5.2 million lbs), which reflects the current above average stock abundance (MSAP 2003). The commercial fishery is allocated 55% of the TAC, and the recreational fishery is allocated 45% of the TAC (Ansley et al. 2003). In 2002/03, Gulf Spanish mackerel commercial landings were only 30.8% of their allocation; landings have been below the TAC since the 1990s (Figure 15) (MSAP 2003). The 2003 MSAP meeting recommended an ABC of 6.3 million lbs for Gulf Spanish mackerel (MSAP 2003). In the recent past, the GMFMC has not followed the advice of the MSAP and set the TAC for Gulf Spanish mackerel at levels higher than the median recommended ABC, although the TAC has been set within the confidence interval of recommended ABC values (MSAP 2003).

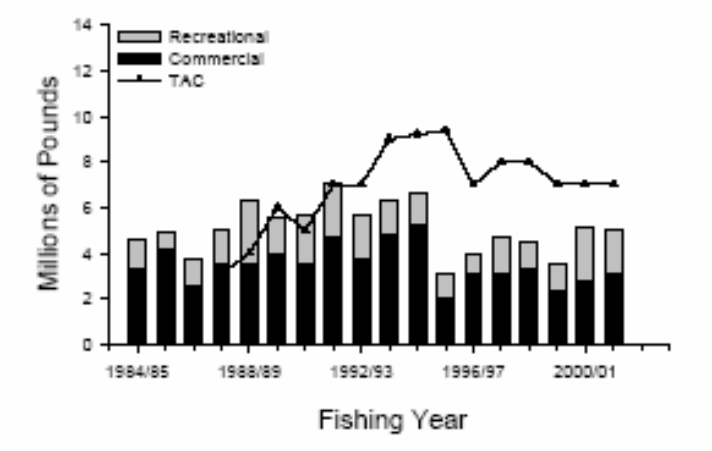


Figure 14. Atlantic Spanish mackerel TAC and commercial and recreational landings (Figure from MSAP 2003).

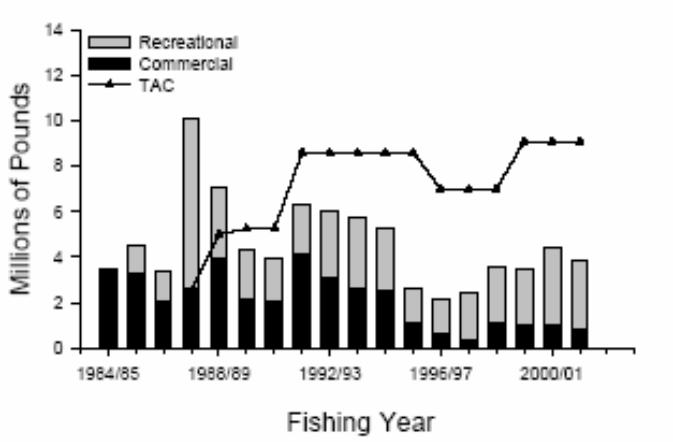


Figure 15. Gulf Spanish mackerel TAC and commercial and recreational landings (Figure from MSAP 2003).

Table 6. Federal commercial fishery management measures for Spanish and king mackerel.

Management Jurisdictions & Agencies	Total Allowable Catch	Size Limit	Gear Restrictions	Trip Limit	Closed Seasons	Sources
Atlantic Spanish mackerel	33.87 mil lbs (commercial quota only)	12 in FL	Purse seines and drift gillnets are prohibited	From GA to NY, catch limit of 3,500 lbs/vessel/day. From east coast of FL to Dade-Monroe County, catch restrictions vary by month and % allocation harvested.	Season opens 4/1 and closes 3/31 or when quota is filled	SAFMC 2004
Gulf Spanish mackerel	5.19 mil lbs (commercial quota only)	12 in FL	None	None	Season opens 4/1 and closes when quota filled	GMFMC 2003
Atlantic king mackerel	3.71 mil lbs (commercial quota only) TAC = 10.0 mil lbs	24 in FL	For king mackerel north of Cape Lookout, NC all gear authorized except for gillnets & long gillnets; south of Cape Lookout, minimum mesh size for runaround gillnets; no > 400,000 lbs may be harvested by purse seines	From NY to Flager/Volusia County, FL from 4/1 to 03/31, trip limit is 3,500 lbs; from Flager/Volusia to Volusia/Brevard County lines from Apr to 10/31, trip limit is 75 fish; in Monroe County, FL from 4/1 to 10/31 the trip limit is 1,250 lbs	Season opens 4/1 and closes 3/31 or when quota is filled	SAFMC 2004
Gulf king mackerel	3.26 mil lbs (commercial quota only) TAC = 10.2 mil lbs	24 in FL	None	EASTERN ZONE: <u>FL east coast subzone</u> 1) 11/1-3/31 50 fish/trip until quota filled 2) 4/1-10/31 SA regulations apply <u>FL west coast subzone (gillnets)</u> 25,000 lbs/trip <u>FL west coast subzone (hook-and-line)</u> 7/1 until 75% gear quota – 1,250 lbs/trip. Then 500 lbs/trip until gear quota filled WESTERN ZONE: 3,000 lbs/trip until quota filled	None	GMFMC 2003

Table 7. State regulations for Spanish mackerel (Table from Ansley et al. 2003).

State	Recreational	Commercial	Management measures
NY	14"; 15 fish	14"	3,500 lb. commercial possession limit per vessel
NJ	14"; 10 fish	14" TL	
DE	14" TL; 10 fish	No fishery	
MD	14"; 15 fish	14"	Declaration allowing regulation through framework; gillnet mesh sizes for Chesapeake Bay
PRFC	14"; 15 fish	14"	
VA	14" TL; 15 fish	14" TL	Size limit exemption for pound net fishery; closure when quota reached; 3,500 lb. trip limit
NC	12" FL; 15 fish	12" FL	3,500 lb. commercial trip limit (Spanish and king mackerel combined); finfish excluder devices required in shrimp trawls; purse gillnet prohibition
SC	12" FL; 15 fish	12" FL	Federal commercial harvest restrictions apply; federal permit required to exceed bag limit; state license required to land/sell
GA	12" FL; 15 fish	12" FL	Commercial landings from state waters limited to bag limits; gillnets/longline gear prohibited in state waters; state waters closed Dec 1- Mar 15; commercial landings (3,500 trip limit) from federal waters by federally permitted vessels allowed year-round as long as the federal quota remains open
FL	12" FL; 15 fish	12" FL	3 ½ " minimum mesh size, 600 yd. maximum length net; commercial daily trip limits vary seasonally

King mackerel

King mackerel are also managed under the Coastal Migratory Pelagic Resources FMP. While there is no interstate commission management plan, individual states manage king mackerel by implementing size limits, possession limits, seasons, and quotas that are compatible with the requirements of the federal FMP. In the original FMP, king mackerel in the South Atlantic and Gulf of Mexico were managed as a single stock; Amendment 1 recognized the existence of two separate, migratory stocks as a result of mark-recapture studies (DeVries 2003). Several studies have also suggested the existence of three distinct stocks in the western Gulf of Mexico, eastern Gulf of Mexico, and Atlantic (Trent et al. 1987b; Fable et al. 1990; Grimes et al. 1990; Johnson et al. 1994; DeVries and Grimes 1997). The eastern and western Gulf of Mexico stocks migrate simultaneously into the northern Gulf of Mexico, where they mix from Texas to northwest Florida (Johnson et al. 1994). Mark-recapture data (Cummings-Parrack 1993) and otolith shape analysis (DeVries et al. 2002) indicate that winter landings of king mackerel from the eastern Gulf of Mexico and Atlantic are primarily from the Atlantic stock. DeVries et al. (2002) found that 99.8% were from the Atlantic stock, and only 0.2% were from the Gulf of Mexico stocks. If all king mackerel from the mixing area were assigned to the Atlantic group, the Gulf group ABC would decrease by approximately 550 mt (Legault 1998). The determination of mixing rates of these stocks has important implications for management of king mackerel.

The Gulf migratory group is further subdivided into the Eastern and Western Zones, demarcated by the Alabama-Florida border; the Eastern and Western Zones receive 69% and 31% of the commercial allocation, respectively (GMFMC 1999). While the Gulf group has been considered

overfished for more than 10 years, the Atlantic group has not – the delineation of the stocks may have important consequences for stock structure and management measures (DeVries 2003).

Landings of Atlantic king mackerel have generally been below TAC by 50 – 74% since the 1999/00 fishing year (Figure 16) (MSAP 2003). The MSAP recommended an ABC of 5.2 million lbs for Atlantic king mackerel for fishing year 2003/04 (MSAP 2003), and 5.8 million lbs for 2005/06 (SEDAR 2004). Although the SAFMC has adopted a TAC of 10.0 million lbs for Atlantic king mackerel, landings have averaged close to the median estimate of maximum sustainable yield (MSAP 2003).

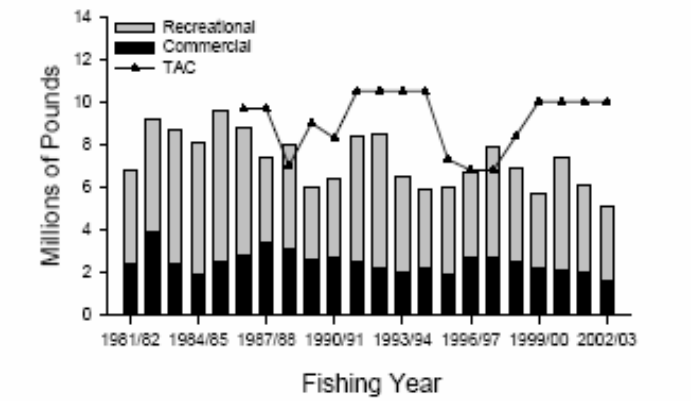


Figure 16. Atlantic king mackerel TAC and commercial and recreational landings (Figure from MSAP 2003).

Gulf king mackerel were first declared overfished in 1985, after a stock assessment found that stocks were in danger of collapsing if fishing mortality was not reduced (Godcharles 1999). Landings of Gulf king mackerel since the 1981/82 fishing year have ranged from 3.0 million lbs to 12.3 million lbs (SEDAR 2004). Total annual harvest levels of Gulf king mackerel exceeded the TAC from the 1986/87 fishing year to 1996/97, but harvest levels have been below the TAC from 1997/98 to 2002/03 (Figure 17) (SEDAR 2004). Decreased landings result in lower fishing mortality projections, and therefore higher spawning biomass projections (SEDAR 2004). However, year classes exhibiting lower recruitment may be entering the fishery, leading to a decrease in spawning stock biomass (SEDAR 2004). If landings are approximately equal to current TAC (10.2 million lbs), there is a higher potential for this to occur (SEDAR 2004). The MSAP recommended an ABC of 8.3 million lbs for fishing year 2005/06, which is lower than the current TAC (SEDAR 2004). Mixing rates of the Atlantic and Gulf groups of king mackerel have important consequences for management. Sensitivity runs of the model that considered different stock compositions in the mixing zone showed that the status of Gulf king mackerel was affected by the mixing rates (SEDAR 2004). Some model runs indicated that the stock was overfished, and overfishing was occurring in 2002/03 (SEDAR 2004).

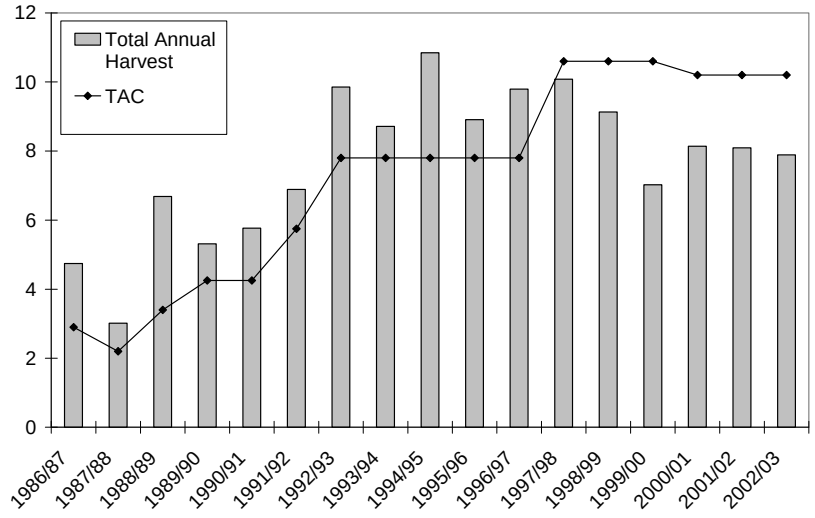


Figure 17. TAC and total annual harvest of Gulf king mackerel, 1986/87 – 2002/03 (SEDAR 2004).

Management summary

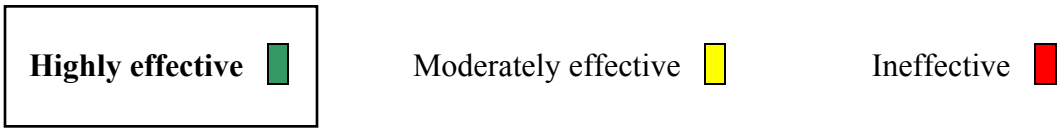
No measures are necessary to mitigate habitat damage, as the fishing methods used to harvest Spanish and king mackerel are considered benign. One conservation measure that has been implemented, via Amendment 13 to the Coastal Migratory Pelagic Resources FMP, is the establishment of two marine reserves near the Dry Tortugas; fishing for coastal pelagics is prohibited in these two reserves. Logbook reporting is required for every vessel with a federal permit to land Spanish and king mackerel (Poffenberger 2004). In the past the GMFMC has ignored the advice of the MSAP, and set TAC above the panel's recommended ABC (MSAP 2003). The TAC has, however, fallen within the recommended range of the MSAP, although it has often been set at the upper limit of the range. In recent years, the SAFMC has generally followed the MSAP recommendation for ABC based on the median probability of achieving the target rate of $F_{40\%SPR}$. The GMFMC has requested an ABC range based on the less conservative limit reference of $F_{30\%SPR}$.

Although Amendment 6 to the Coastal Migratory Pelagic Resources FMP mandates full stock assessments every other year, and Amendment 8 mandates full stock assessments in even numbered years, the most recent full assessments for the mackerel migratory groups were in 1998, 2003 (GMFMC 2003b), and 2004. Full assessments were conducted in 2003 for three of the four migratory groups (Atlantic Spanish, Atlantic king, and Gulf Spanish mackerel) (GMFMC 2003b). The 2004 stock assessment included Gulf king mackerel. Management regularly collects and assesses fishery dependent and independent data; CPUE data are collected from multiple sources, and different indices are used for the different migratory stocks. Bycatch is a moderate conservation concern for the Spanish and king mackerel fisheries. Efforts to reduce bycatch include a purse gillnet prohibition in North Carolina state waters for Spanish mackerel, and the gillnet prohibition in Florida state waters. In general, management has maintained stock productivity and limited ecosystem change.

EFFECTIVENESS OF MANAGEMENT RANK

Management has completed a recent stock assessment, and regularly collects both fishery independent and dependent data. Efforts have been made to reduce bycatch, but no mitigative measures are necessary to address habitat damage, as the fishing methods for Spanish and king mackerel are considered benign with respect to effects on marine habitat and ecosystems. Fishery regulations are enforced, and management has generally maintained stock productivity and limited ecosystem change. Although management has set the TAC higher than the median recommended ABC on several occasions, the TAC has only exceeded the maximum recommended ABC three times over the last 17 years. Overall, management of the Atlantic and Gulf of Mexico stocks of Spanish and king mackerel rates as highly effective.

Effectiveness of Management Rank:



Overall Evaluation and Seafood Recommendation

Life history characteristics, such as early age at first maturity and a low maximum age make Spanish and king mackerel inherently resilient to fishing pressure. Atlantic Spanish, Gulf Spanish, and Atlantic king mackerel stocks are considered healthy. Although Gulf king mackerel are not overfished, this stock is considered weak, as the stock has only recently begun to recover from an overfished condition. There is a moderate level of bycatch associated with the Spanish and king mackerel fisheries, due to finfish bycatch in the handline fishery and marine mammal bycatch in the gillnet fishery. The habitat and ecosystem effects of the fishing gear used to harvest Spanish and king mackerel are benign, and are of a low conservation concern. Management measures have generally maintained stock productivity, and management of Spanish and king mackerel in the South Atlantic and Gulf of Mexico is considered highly effective. Overall, this suite of factors leads to a seafood recommendation of "Best Choices" for Spanish and king mackerel.

Table of Ranks

	Conservation Concern			
Sustainability Criteria	Low	Moderate	High	Critical
Inherent Vulnerability	√			
Status of Stocks	√ (Atlantic and Gulf Spanish, Atlantic king)	√ (Gulf king)		
Nature of Bycatch		√		
Habitat Effects	√			
Management Effectiveness	√			

OVERALL SEAFOOD RECOMMENDATION:

Best Choices Good Alternative Avoid

Supplemental Information

Although potential health effects are not a factor in the Seafood Watch® recommendation, the consumption of king mackerel may be a health concern for certain individuals. The USFDA and USEPA recommend that women and young children should not consume king mackerel due to high mercury content (CFSAN 2004). State of Florida guidelines recommend that fish containing 0.5 to 1.5 parts per million (ppm) of total mercury should be consumed in limited amounts, and fish containing greater than 1.5 ppm of mercury should not be consumed (Adams and McMichael 2001). From April 1989 to January 1995, the Florida Marine Research Institute tested mercury levels in estuarine and marine fishes from Florida state waters. Of the 66 king mackerel tested, 95% from the Gulf coast of Florida had total mercury levels greater than or equal to the 0.5 ppm level, and 54% had total mercury levels greater than the 1.5 ppm level (Adams and McMichael 2001). Total mercury levels for individual fish averaged 1.72 ppm (0.25 – 4.0 ppm range), and were correlated with fish length (Adams and McMichael 2001). In another study, 213 king mackerel were tested in the Gulf of Mexico; the mean mercury concentration was 0.73 ppm (0.23 – 1.67 ppm range) (USFDA 2004). King mackerel are one of four species recognized as having the highest concentrations of mercury (USFDA 2004).

In Florida waters, Spanish mackerel also had relatively high total mercury levels, with a mean of 0.47 ppm for fish in the Indian River Lagoon region, and 0.69 ppm in Charlotte Harbor (Adams and McMichael 2001). Of the legal-sized Spanish mackerel tested, 65% had total mercury levels equal to or greater than the 0.5 ppm threshold level (Adams and McMichael 2001). As with king mackerel, total mercury levels were correlated with fish length. Another study concluded that 66 Spanish mackerel sampled from the Gulf of Mexico had a mean mercury concentration of 0.45 ppm (0.07 – 1.56 ppm range); in the South Atlantic the mean concentration for 43 fish was 0.18 ppm (0.05 – 0.73 ppm range) (USFDA 2004).

For information on individual state consumption advisories, visit the EPA's Fish Advisories home page: http://www.epa.gov/ost/fish/states.htm.

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