



CHAPTER 2.1.10.6: SPANISH MACKEREL	AUTHORS: T. FRÉDOU, F. LUCENA-FRÉDOU, R. SIQUEIRA LIMA (UFRPE) and B. MOURATTO (UNIFESP)	LAST UPDATE: 30 June 2021 Original: English
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2.1.10.6 Description of Spanish mackerel (SSM)

1. Names

1.a. Classification and Taxonomy

Species name: *Scomberomorus maculatus* (Mitchill, 1815)

ICCAT species code: SSM

ICCAT names: Spotted Spanish mackerel (English), Carite atlántico (Spanish), Maquereau espagnol (French).

According to Collette and Nauen (1983), the Spanish mackerel is classified as follows:

- Phylum: Chordata
- Subphylum: Vertebrata
- Infraphylum: Gnathostomata
- Superclass: Pisces
- Class: Actinopterygii
- Order: Perciformes
- Suborder: Scombroidei
- Family: Scombridae
- Subfamily: Scombrinae
- Genus: *Scomberomorus*:
- Species: *Scomberomorus maculatus*

1.b. Common names

List of vernacular names used by different countries according to ICCAT, FAO and Fishbase (www.fishbase.org).

The list of countries is not exhaustive and some local names might not be included.

Barbados: Spanish mackerel.

Brazil: Sororoca, Serra.

China Main: 橢斑馬鮫.

Colombia: Sierra.

Cuba: Sierra.

Denmark: Plettet kongemakrel.

Former USSR: Ispanskaya makrel, Korolevskaya pyatnistaya makrel, Pyatnistaya makrel.

France: Thazard Atlantique, Thazard blanc.

Germany: Gefleckte Königsmakrele.

Guinea: Makréni.

Italy: Sgombro macchiato.

Martinique: Taza doré, Thazard tacheté du sud.

Mexico: Carite, Pintada, Sierra, Sierra común.

Poland: Makrela hiszpanska.

Portugal: Serra-espanhola.

Russian Federation: Ispanskaya makrel, Korolevskaya pyatnistaya makrel, Pyatnistaya makrel; макрель испанская.

South Africa: Spaanse makriel, Spanish mackerel.

Spain: Carita atlántico.

Sweden: Fläckig kungsmakrill.

UK: Atlantic spanish mackerel.

USA: Spanish mackerel.

Venezuela: Carite, Sierra pintada.

2. Identification

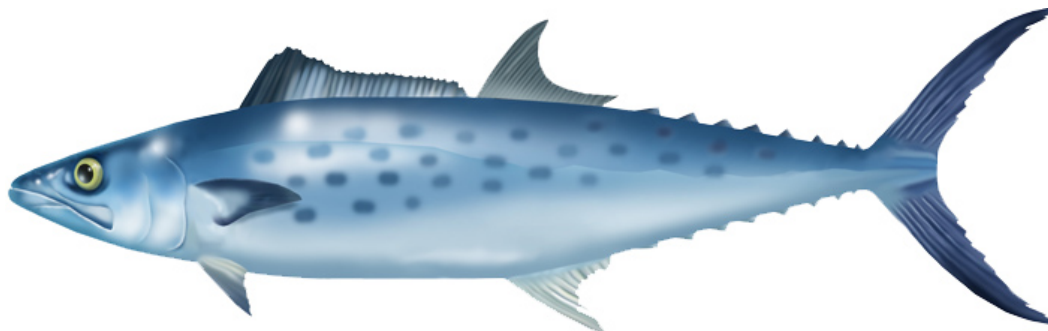


Figure 1. Drawing of an adult Spanish mackerel (by A. López, 'Tokio').

Characteristics of *Scomberomorus maculatus* (see Figure 1 and Figure 2)

Spanish mackerel is a small tuna species. Maximum size is 80.2 cm fork length (Fable *et al.*, 1987) and 5.89 kg weight (IGFA, 2010).

Colour:

- Colour silver on sides marked with about three rows of round to elliptical spots (bronze, yellow in life), but no stripes.
- Black area on the anterior part of the first dorsal fin, posterior membranes white.

External:

- Body elongated and strongly compressed. Body entirely covered with small scales.
- Snout much shorter than rest of the head.
- Posterior part of maxilla exposed.
- Gill rakers on first arch: 1-4 on upper limb; 8-13 on lower limb; 10-16 total.
- Two scarcely separated dorsal fins. First dorsal with 17-19 spines. Second dorsal with 17-20 (usually 18 or more), followed by 7-9 finlets.
- Anal fin with 17-20 rays followed by 7-10 finlets.
- Pectoral fin with 20-23 rays (usually 21).
- Lateral line gradually curving down toward caudal peduncle.
- Inter-pelvic process small and bifid. Pelvic fins relatively long.

Internal:

- Swim bladder absent.
- Vertebrae: 51-53.
- Intestine with 2 folds and 3 limbs.

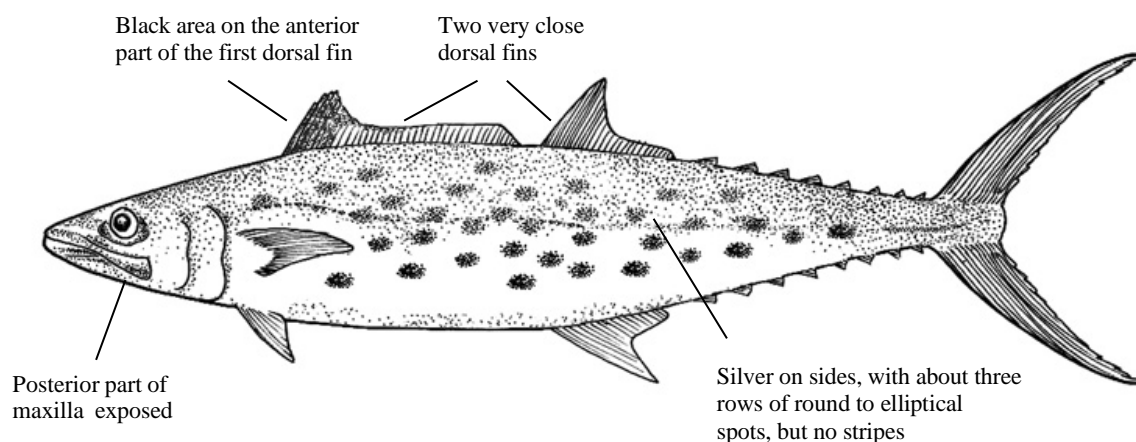


Figure 2. Synthesis of the most outstanding characteristics of Spanish mackerel (by A. López, 'Tokio').

3. Distribution and population ecology

3.a. Geographical distribution

This species is restricted to the Northwest Atlantic, distributed along the coast of Canada and the United States, from Cape Cod to Miami, and along the Gulf of Mexico, from Florida to Yucatan (Collette and Nauen, 1983; Scott and Scott, 1988). Absent in the Bahamas (Smith, 1997).

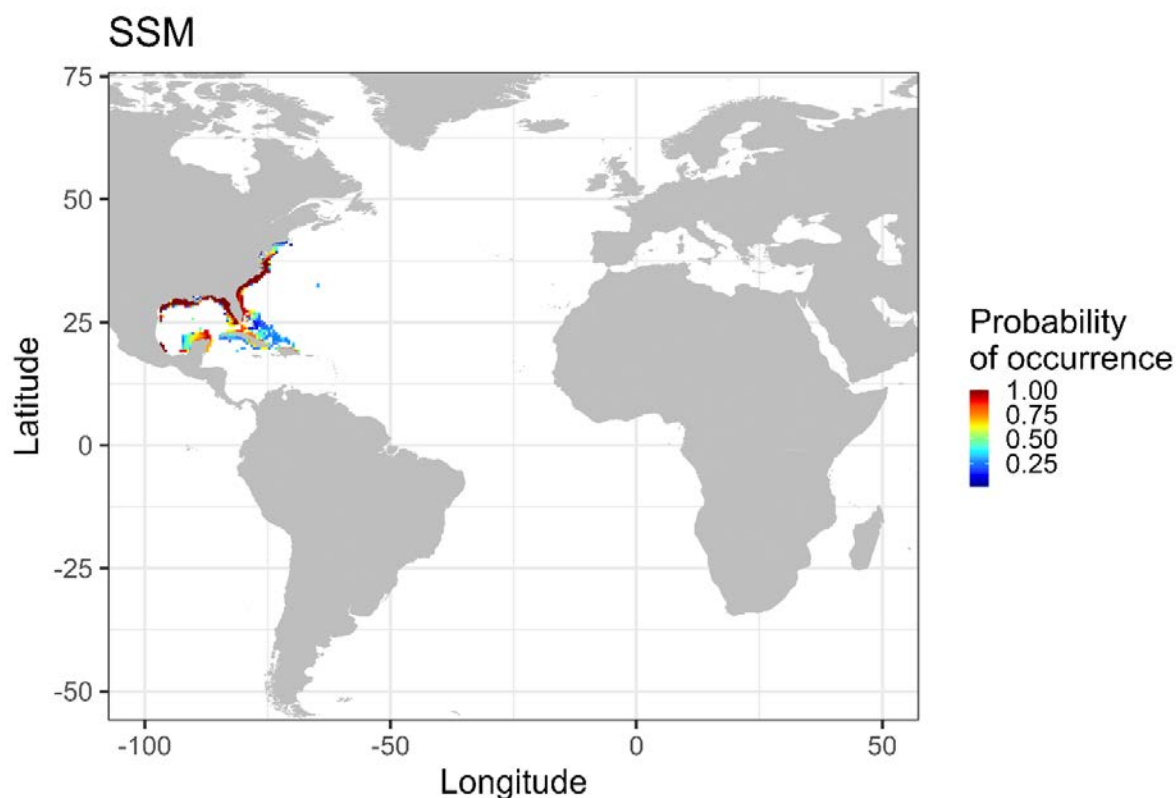


Figure 3. Spanish mackerel spatial distribution based on data available on the website aquamaps.org. Distribution range colours indicate the level of probabilities of occurrence.

3.b. Habitat preferences

The Spanish mackerel is an epipelagic, coastal migratory pelagic species, typically completing its lifecycle off open beach waters (Schrandt *et al.*, 2015).

3.c. Migrations

Large schools migrate over great distances along the shore. With the increase of the water temperatures, Atlantic Spanish mackerel move northward, from Florida, along the Atlantic coast of the USA, to Narraganset Bay, Rhode Island, between late February and July, returning during the fall. It overwinters off Florida. There are also schools migrating westwards in early spring, reaching Texas in late March. North-south movements along the Mexican coast occur between August and November, and the inverse movement is registered in March and April (Collette and Nauen, 1983).

Mark recapture studies suggested that Atlantic Spanish mackerel made an annual migration from wintering grounds off South Florida and Campeche-Yucatan to summer grounds along the northern Gulf coast, returning during the fall (Sutherland and Fable, 1980).

4. Biology and life history parameters

4.a. Growth

Available growth parameters of Spanish mackerel were compiled in **Table 1**. Parameters were discriminated by stock as attributed by the Fishery Management Council Fishery during its Southeast Data, Assessment, and Review periodic workshops (SEDAR, for SEDAR's Stock definition, see 4.i for details). L_{∞} and k values present high variability in both the Gulf of Mexico (55 to 79.4 cm fork length FL, 0.24 to 0.648 y^{-1} respectively) and the Northwest Atlantic (53.8 to 76 cm FL, 0.18 to 0.4 y^{-1} respectively) (**Table 1**). Overall, females grow larger than males (Mendizabal y Oriza, 1987, Schmidt *et al.*, 1993). In the Northwest Atlantic, the oldest male was age 6 and, the oldest female, age 11 (Schmidt *et al.*, 1993). In the Gulf of Mexico, the oldest male was age 7 and, the oldest female, 9 (Mendizabal y Oriza, 1987).

Table 1. Growth parameters for *Scomberomorus maculatus* (L_{∞} in cm, K in y^{-1} , t_0 in y).

L_{∞}	k	t_0	Method	Area*	Source
70	0.4	-0.23	Size-frequency	Gulf of Mexico stock	Chávez, 1994
73.9	0.33	-0.99	Otoliths	Gulf of Mexico stock	Fable <i>et al.</i> , 1987
79.4	0.24	-0.94	Otoliths	Gulf of Mexico stock	Fable <i>et al.</i> , 1987
72	0.4	0.28	Otoliths	Northwest Atlantic stock	Klima, 1959
60.7	0.4	0.15	Otoliths	Northwest Atlantic stock	Klima, 1959
70.5	0.36	0.36	Size-frequency	Gulf of Mexico stock	Medina-Quej and Dominguez Viveros, 1997
58.28	0.648	298	Otoliths	Gulf of Mexico stock	Mendizabal y Oriza, 1987
54.97	0.51	301	Otoliths	Gulf of Mexico stock	Mendizabal y Oriza, 1988
67.26	0.42	165	Otoliths	Gulf of Mexico stock	Mendizabal y Oriza, 1989
73.1	0.38	-0.73	Otoliths	Gulf of Mexico stock	Powell, 1975
77.6	0.27	-0.73	Otoliths	Gulf of Mexico stock	Powell, 1975
76	0.18	-2.44	Otoliths	Northwest Atlantic stock	Schmidt <i>et al.</i> , 1993
72.3	0.24	-1.8	Otoliths	Northwest Atlantic stock	Schmidt <i>et al.</i> , 1993
53.8	0.31	-2.31	Otoliths	Northwest Atlantic stock	Schmidt <i>et al.</i> , 1993

4.b. Length-weight relationship

Published length-weight relationships for several geographical areas in the Atlantic are showed in **Table 2**.

Table 2. Published Spanish mackerel length-weight relationships. SL: Standard Length, TL: Total Length, FL: Fork Length

Equation	N	Length range (cm)	Sex	Area	Reference
$W=0.0000115 \times SL^{2.9822}$	135	-	M	South Florida	Powell, 1975
$W=0.0000048 \times SL^{3.1373}$	217	-	F	South Florida	Powell, 1975
$W=0.0000010 \times SL^{3.0076}$	352	-	All	South Florida	Powell, 1975
$W=0.0000250 \times FL^{2.83}$	482	-	All	Gulf of Mexico	Medina Quej, and Dominguez Viveros, 1997
$W=0.0000105 \times FL^{2.95842}$	35	-	-	Southeast Florida	Beardsley and Richards, 1970
$W=0.0000545 \times FL^{2.727}$	-	-	-	Gulf of Mexico	Chávez, 1994
$W=0.0000143 \times FL^{2.9292}$	2005	20-67	All	Gulf of Mexico	Finucane and Collins, 1986
$W=0.000014002 \times FL^{2.9302}$	625	22-70	All	Southeast Florida	Finucane and Collins, 1986
$W=0.006700000 \times TL^{2.9749}$	4755	-	-	Gulf of Mexico	Mendizabal y Oriza, 1987

There is no conversion factor available for this species in the literature.

4.c. Reproduction

- *Spawning*

Spawning takes place from May through September for all areas. Spawning season by stock is shown in **Table 3**.

Table 3. Spawning period of the Spanish mackerel off the Atlantic Ocean and the Gulf of Mexico.

Location - ICCAT	J	F	M	A	M	J	J	A	S	O	N	D	Reference
Northwest Atlantic stock													Cooksey, 1996
Northwest Atlantic stock													Klima, 1959
Gulf of Mexico stock													Mendizabal y Oriza, 1987
Northwest Atlantic stock													Schmidt <i>et al.</i> , 1993
Gulf of Mexico stock													Powell, 1975

- *Maturity*

Fork length at first maturity off Florida varies between 28 to 34 cm for males and 25 to 37 cm for females (Klima, 1959). In the South Atlantic coast of USA, mature gonads were present in 89% of age-0 males and 100% of older ages, whereas 5% of females were mature at age 0, 95% at age 1, and 100% at older ages. In this area, females matured at 28.8-45 cm FL, and males at 20.9-33.6 cm FL. Two studies were carried out in the Northwest Atlantic, and estimates of length at 50% maturity (L_{50}) were discrepant for females, 35.8 cm and 23 cm FL (Schmidt *et al.*, 1993 and Cooksey, 1996 respectively). Males L_{50} estimates were similar for both studies, 23.9 cm and 23.2 FL cm (Schmidt *et al.*, 1993 and Cooksey, 1996 respectively). In Trinidad, the first spawning takes place at ages 2 and/or 3 for both sexes (Sturm, 1978).

Estimates of length at sexual maturity of Spanish mackerel off the Atlantic Ocean and Gulf of Mexico stocks are summarized in **Table 4**.

Table 4. Published Spanish mackerel estimates of length at first maturity in the Atlantic Ocean.

L₅₀	Sex	Stock name	Reference
23.1	Unsexed	Northwest Atlantic stock	Cooksey, 1996
23	Females	Northwest Atlantic stock	Cooksey, 1996
23.2	Males	Northwest Atlantic stock	Cooksey, 1996
28.0	Unsexed	Northwest Atlantic stock	Schmidt <i>et al.</i> , 1993
35.8	Females	Northwest Atlantic stock	Schmidt <i>et al.</i> , 1993
23.9	Males	Northwest Atlantic stock	Schmidt <i>et al.</i> , 1993

- *Sex ratio*

In Trinidad, it was reported a sex-ratio of is 1:1, similar to the observed in southeast Florida (Klima, 1959) and Chesapeake Bay (Cooksey, 1996). However, males outnumbered females in the Gulf of Paria, where spawning activity is concentrated (Sturm, 1978).

- *Fecundity*

In Trinidad, egg counts from 12 ripe females ranged from 26,057 to 149,736 (Sturm, 1978). In Mexican waters, mean fecundity for sizes between 45 and 56.5 cm, was estimated as 150,000 ovula (Vasconcelos Perez, 1976). Spanish mackerel caught in the Chesapeake Bay had their batch fecundity ranging from 34,000 to 145,000 eggs per batch. Mean batch fecundity was 74,077 eggs per batch (Cooksey, 1996).

4.d. First life stages

Eggs and larvae

Eggs are pelagic, 0.90-1.30 mm in diameter and with one oil globule. The yolk is homogeneous. The hatch size is 2.56 mm. Larvae present pigmentation on the forebrain, midbrain, over the gut, cleithral symphysis, ventral margins of the tail, usually a distinct patch on the gular area (Richards, 2005). Larvae are encountered in surface waters of 19.6° C - 29.8°C (McEachran *et al.*, 1980).

4.e. Diet

The species feeds primarily on fishes, especially clupeids (*Opisthonema*, *Anchoa*), carangids and engraulids, with smaller quantities of penaeoid shrimps and squids. The percentage of anchovies consumed is higher for juveniles than for adults (Naughton and Saloman, 1981; Finucane *et al.*, 1990, Bowman *et al.*, 2000).

Predators: various pelagic fish including *Morone saxatilis*, *Pomatomus saltator* and *Cynoscion regalis*.

4.f. Physiology

There is a lack of information on this topic.

4.g. Behaviour

This species makes large schools of similar-sized individuals. A coordinated predatory behaviour among single or mixed species (i.e. *Sphyraena barracuda*, *Seriola dumerili* and *Scomberomorus maculatus*) preying on school of species has been observed in the northwest Atlantic Ocean (Auster *et al.*, 2009).

4.h. Natural mortality

The life history working group (LHG) from SEDAR recommended modelling the natural mortality rate of Spanish mackerel as a declining 'Lorenzen' function of size (translated to age by use of a growth curve) (Lorenzen, 1996), scaled to the Hoenig (fish) point estimate for the fully recruited ages from 2 to 12 years. These estimates ranged from 0.22 – 0.37 (SEDAR, 2012, 2013).

4.i. Populations/Stock structure

The Spanish mackerel range encompasses the Gulf of Mexico and Northwest Atlantic. Evidence suggests that western Atlantic and Gulf migratory groups of Spanish mackerel are not genetically distinct (Buonaccorsi *et al.*, 2001). However, the Fishery Management Council split the Atlantic stock and Gulf of Mexico stock for management purposes (SEDAR, 2012, 2013).

5. Description of fisheries

The Atlantic Spanish mackerel is a valued fish to recreational or commercial fisheries throughout its range. The USA fishery uses trolling lines, gillnets, and pound nets. Larger vessels use sometimes airplane spotting to locate the fish. Recreational anglers catch Spanish mackerel from boats while trolling or drifting and from boats, piers, jetties, and beaches by casting, live bait fishing, jigging, and drift fishing (Trent and Anthony, 1979; Palko *et al.*, 1987). Fishermen in Veracruz employ beach seines (chinchorros playeros), gillnets (redes agalleras) trolling lures (curricanes) and trap nets (almadrabas). Driftnet and trawl shrimp fisheries capture juveniles of Spanish mackerel as bycatch (Harris and Dean, 1996; Collins and Wenner, 1988).

The fisheries along the Atlantic US coast North of southern Florida, and in the Gulf of Mexico are seasonal between spring and late summer or fall, depending on species migrations, while in southern Florida operations are concentrated in the winter months, from October to February or March (Klima, 1959).

Total catch is probably underestimated due to reporting of unclassified *Scomberomorus* species captures as well as the probably inadequate reporting of artisanal and recreational catches (Manooch, 1979). ICCAT catch statistics do not discriminate Northwest Atlantic and Gulf of Mexico stocks. Catches are reported as northwestern Stock. Species annual catches reached 13400 MT in 2019. The average estimated landings, from 2000 to 2019, is 8740 MT (**Figure 4**). The main gears reported recently were Rod-and-reel (RR), Longline (LL) and Gillnet (GN) representing 49%, 29% and 13% of the total respectively (**Figure 5**).

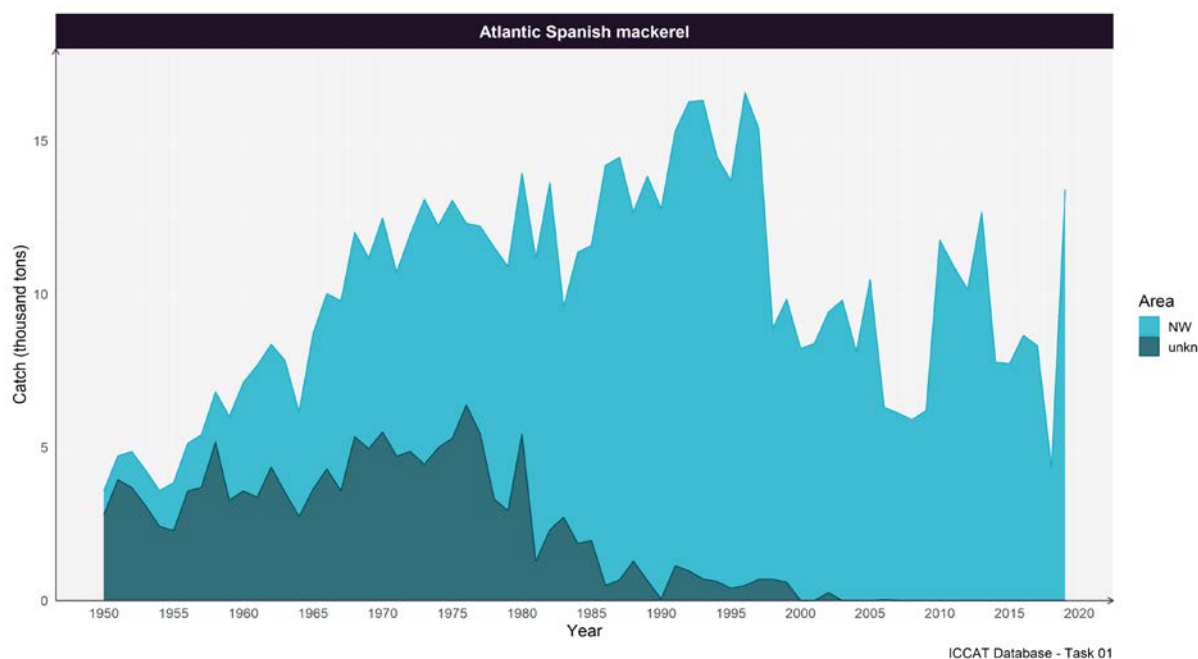


Figure 4. Catch of Spanish mackerel available in the ICCAT database (Task 1) by year from 1950 to 2019. NW (Northwest Atlantic). Unkn (unknown).

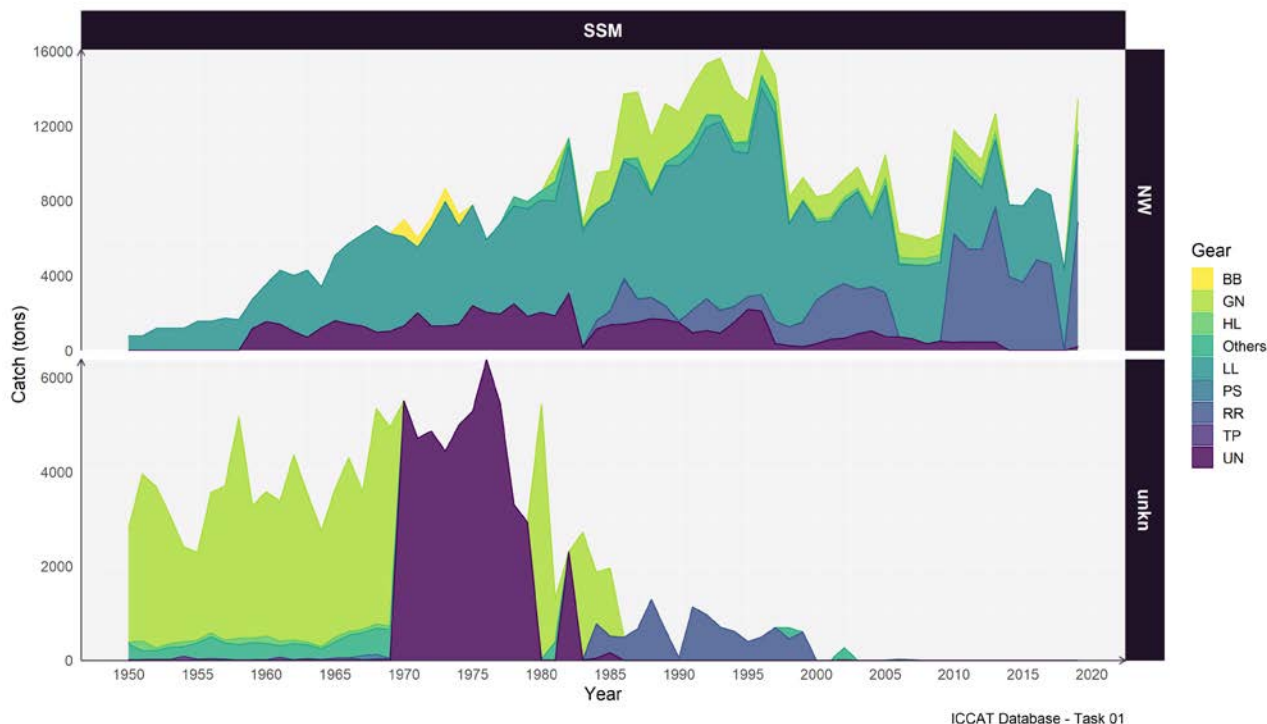


Figure 5. Total catch of Spanish mackerel by fishing gear. BB: baitboats. TP: traps. RR: rod and reel. PS: purse seine. LL: longline. HL: handline. GN: gillnets. UN: unknown. Others included: trawl (TW), trolling (TR), haul seine (HS), trammel net (TN), sport (SP), tended line (TL), and harpoon (HP).

6. Stock assessment

Previous assessments (1983 to 1992) indicated that the stocks of Atlantic Spanish mackerel in the Gulf of Mexico were over-exploited (Powers and Thompson, 1993). Reductions in fishing mortality were considered necessary, and hence a number of regulations (commercial trip limits, seasonal and area quotas, and recreational bag limits) have been implemented in order to allow the stocks to recover to levels that could provide high average long-term yields and to provide adequate safeguards against recruitment failure.

In 2012, the South Atlantic Spanish mackerel stock assessment presented by the SEDAR 28 Assessment Workshop provided results from a statistical catch-age model, the Beaufort Assessment Model (BAM). The current stock biomass status in the base run from the BAM was estimated to be $SSB_{2011}/MSST=2.29$ (MSST - Minimum Stock Size Threshold). The current level of fishing (exploitation rate) was $F_{2009-2011}/FMSY = 0.526$, with $F_{2011}/FMSY = 0.521$, indicating that the stock is not overfished and is not undergoing overfishing (SEDAR, 2012). The Gulf of Mexico Spanish mackerel stock assessment presented by the SEDAR 28 Assessment Workshop provided results from a stock synthesis model (SEDAR, 2013). The group concluded that the stock was not overfished and that overfishing was not occurring (in 2011).

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