CARIBBEAN REGIONAL FISHERIES MECHANISM

Present Status of Fish Resources Caught in Association with Fish Attraction Devices (FADs) and their Management

CRFM / WECAFC-IFREMER-MAGDELESA / CARIFICO

Workshop on FAD Fishery Management

09 – 11 December, 2013

St. Vincent and the Grenadines

Definitions of Technical Terms Indicators of Stock Status

Natural Mortality - M

Percentage of fish in population which die each year from all causes besides fishing (ageing, predation, disease etc.)

M = 0.2 – 20% of population die in a year

usually difficult to estimate for migratory fish, often estimated based on life history and assumed constant

Fishing Mortality – F

Percentage of fish in population which die each year due to fishing.

Biomass (Standing Stock) - B

The total weight of a group (or stock) of living organisms (e.g. fish) or of some defined fraction of it (e.g. spawners), in an area, at a particular time – e.g., Spawning Stock Biomass (SSB)

Definitions of Technical Terms Indicators of Stock Status

Maximum Sustainable Yield – MSY

The largest average catch or yield that can continuously be taken from a stock under existing environmental conditions.

Relative Biomass

Usually Biomass is expressed as a fraction of the biomass necessary for MSY (Bmsy) – e.g. B2007/Bmsy – is the biomass in 2007 relative to Biomass at Maximum Sustainable Yield (MSY) - Ideally if this fraction > 1 then stock is in good shape

Relative Fishing Mortality

Usually Fishing Mortality is expressed as a fraction of the fishing mortality at which the biomass necessary to generate MSY is achieved – e.g. F2007/Fmsy

Ideally if this fraction approaches 1, there is need to reduce fishing mortality through management measures that control fishing effort (e.g. # boats)

Species Caught in Association with FADs of relevance to CRFM Member States

Tropical Tunas (ICCAT)
Yellowfin Tuna
Bigeye Tuna
Skipjack Tuna

Temperate Tuna (ICCAT)
Albacore

Billfishes (ICCAT)
Blue Marlin
White Marlin
Sailfish
Swordfish

Pelagic Sharks (ICCAT)
Shortfin Mako
Blue Shark
Etc.

Small Tunas
Dolphinfish
Wahoo
King Mackerel
Blackfin Tuna
Serra Spanish Mackerel
Cero Mackerel
Little Tunny
Frigate Tuna
Bullet Tuna
Atlantic Bonito

Small Oceanic Pelagic
Four-wing flyingfish

No information available on stock status and management

Others
Barracuda
Triggerfish

Currently Belize, St Vincent and the Grenadines, Barbados and Trinidad and Tobago are Contracting Parties to ICCAT.

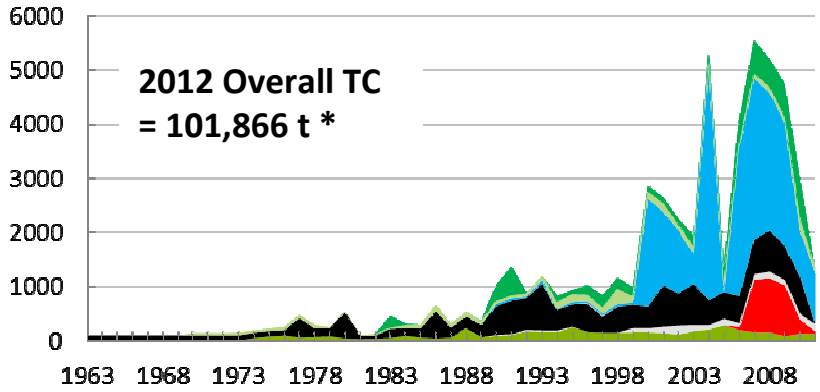
Status of Stocks and Management
Tunas, Billfishes, Sharks

Estimated Catches (t) CRFM – 1963 to 2011

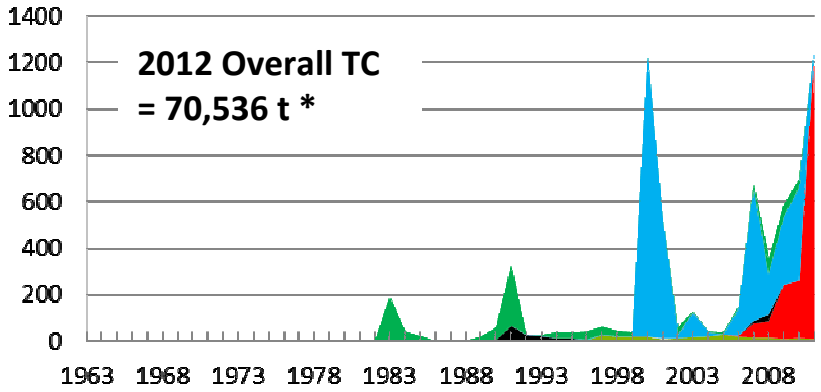
(Source: ICCAT CATDIS Database)

Catches for Relevant Stock harvested by CRFM Member States (ATL, West ATL, North ATL)

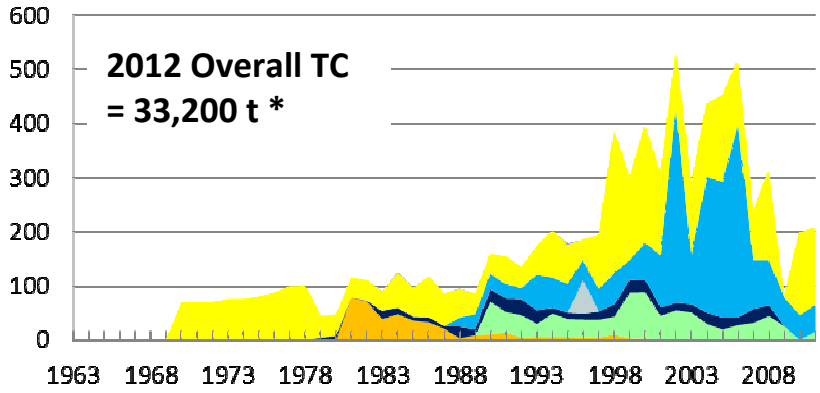
Yellowfin Tuna



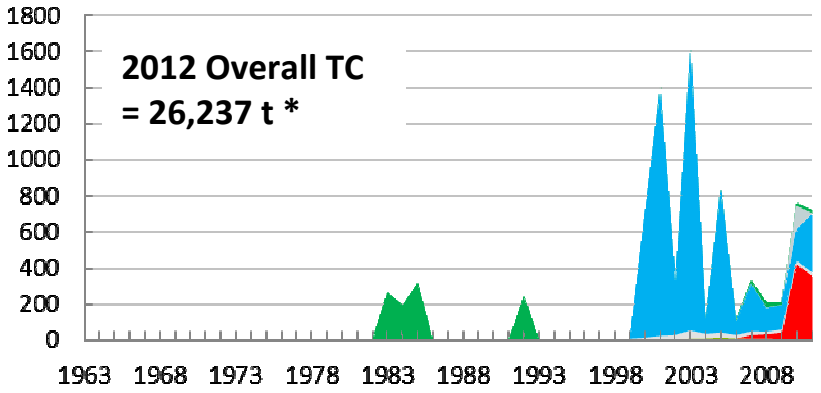
Bigeye Tuna



Skipjack Tuna



Albacore



* Overall TC (total catch) for CRFM and Non-CRFM Countries combined

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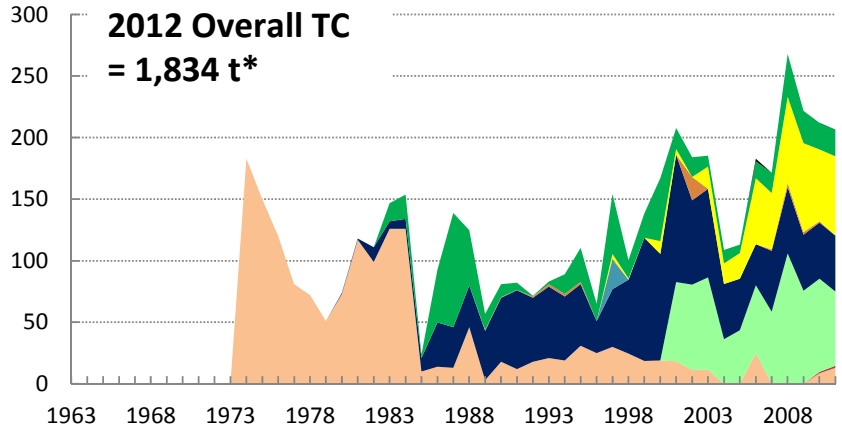
Estimated Catches (t) CRFM – 1963 to 2011

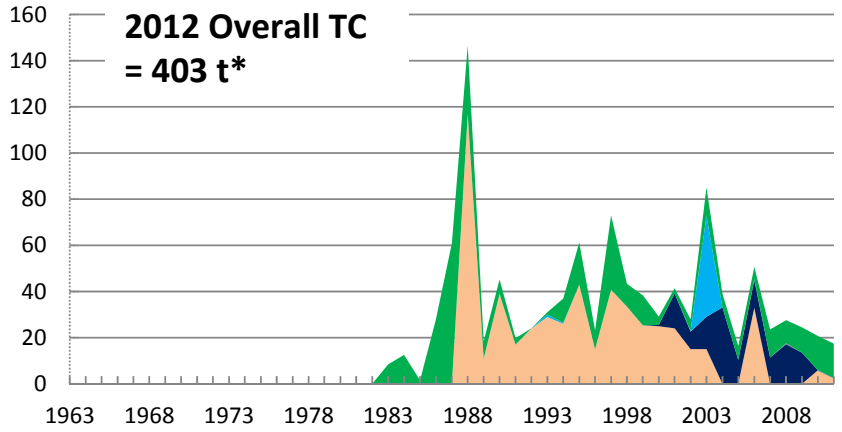
(Source: ICCAT CATDIS Database)

Catches for Relevant Stock harvested by CRFM Member States (ATL, West ATL, North ATL)

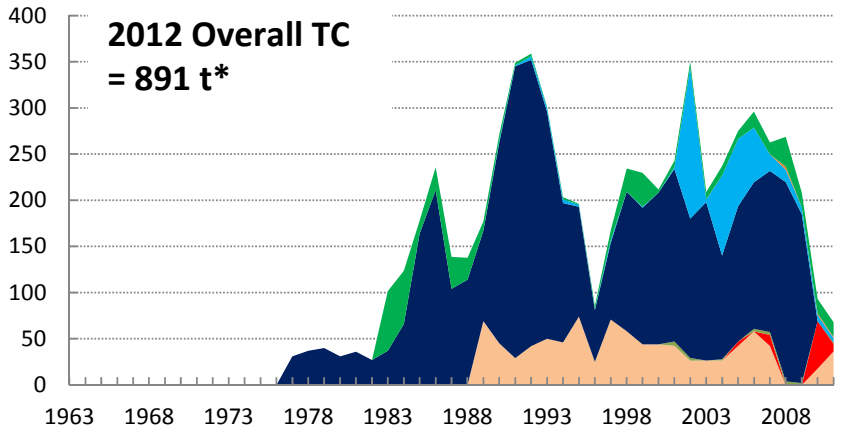
Blue Marlin



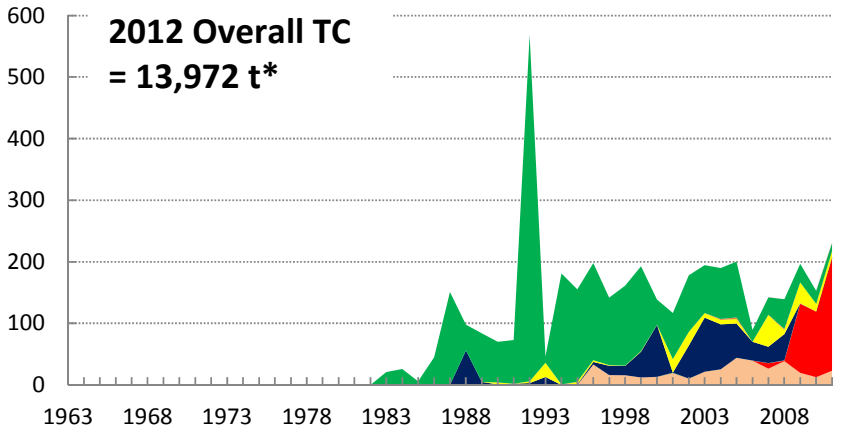
White Marlin



Sailfish



Swordfish



* Overall TC (total catch) for CRFM and Non-CRFM Countries combined

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BIOLOGY

Common Name	Yellowfin Tuna	Bigeye Tuna	Skipjack Tuna	Albacore
Scientific Name	*Thunnus albacares*	*Thunnus obesus*	*Katsuwonus pelamis*	*Thunnus alalunga*
Distribution	Tropical, subtropical - mainly in the epipelagic oceanic waters	Widely distributed- tropical and subtropical waters of Atlantic. Geographical limit: 55°- 60 °N and 45°- 50°S.	gregarious, found in tropical, sub-tropical warm temperate waters	Widely distributed - temperate and tropical waters; from 45-50 °N to 30-40 °S (less abundant in surface waters between 10°N and 10°S)
Spawning Grounds	main ground - equatorial zone of the Gulf of Guinea (January to April); also in Gulf of Mexico, southeastern Caribbean Sea, and off Cape Verde,relative importance of these spawning grounds unknown	entire year, vast zone, around equator, with T > 24°C, from Brazil coast to Gulf of Guinea	breeds opportunistically throughout year over wide areas of the Atlantic	subtropical western areas of both hemispheres and throughout the Mediterranean Sea (spring and summer)
Maturity	Around 100 cm - 3 year old	Around 100-110 cm - 3 year old	depending on areas, 42 - 50 cm	Atlantic: 90 cm (age 5)
Life Span	Around 10 years	Around 15 years	Around 5 years	Atlantic: 15 years
Max. Size	Around 230 cm (180 kg)	Around 200 cm	Around 100 cm (18kg)	Atlantic: 130 cm (40 kg)
Natural Mortality	Assumed to be 0.8 for ages 0 and 1, and 0.6 for ages 2+	Assumed to be 0.8 for ages 0 and 1, and 0.4 for ages 2+	Assumed M = 0.8	Assumed M=0.3

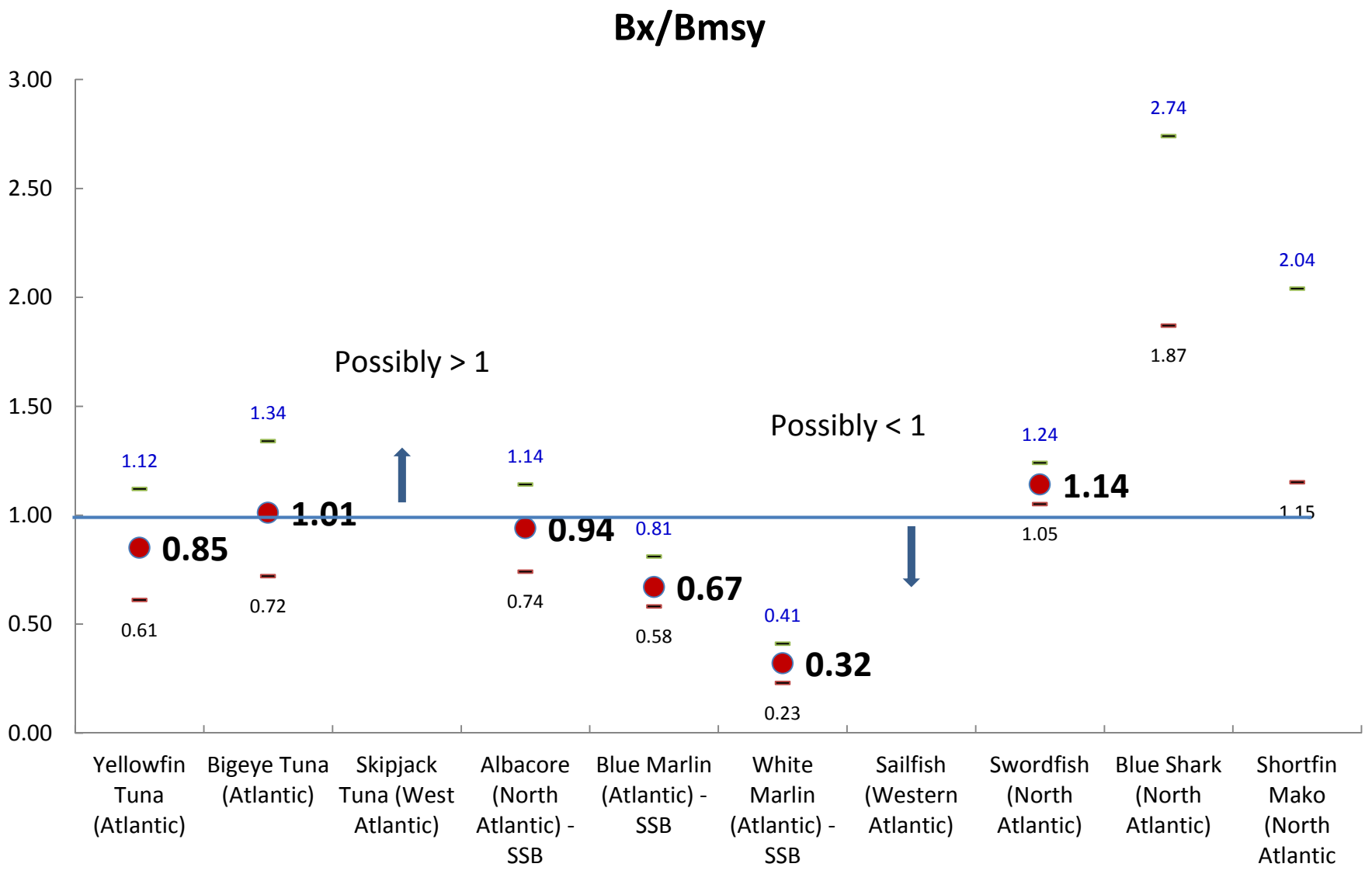
Source: ICCAT SCRS 2013 Report

BIOLOGY

Common Name	Blue Marlin	White Marlin	Sailfish	Swordfish
Scientific Name	*Makaira nigricans*	*Tetrapturus albidus*	*Istiophorus albicans*	*Xiphias gladius*
Distribution	Widely distributed - subtropical and tropical waters, occasionally in temperate waters - from 50°N to 45°S, less abundant in eastern central and south central Atlantic	Widely distributed - subtropical and tropical waters - occasionally in temperate waters and in the Mediterranean Sea - from 55 °N to 45° S, less abundant in waters of eastern central south, central Atlantic.	Widely distributed - subtropical and tropical waters , occasionally in temperate waters and in the Mediterranean Sea - least oceanic of Atlantic billfishes; shows a strong tendency to approach continental coasts, islands and reefs.	Cosmopolitan species - in the tropical and temperate waters of all the oceans, between 45°N and 45°S,including the Mediterranean.
Spawning Grounds	Mainly in tropical western areas of both hemispheres	Mainly in the tropical western areas of both hemispheres	Tropical areas of both hemispheres (almost year round)	In subtropical western areas of both hemispheres and throughout the
Maturity	256 cm (females)	149-160 cm (females) / 139 cm (males)	147-160|180 cm LJFL (females) / 135.7 cm LJFL cm (males)	Atlantic: 180 cm (♀, age 5)
Life Span	11 years (tagging, longest time–at large in the Atlantic)	15 years (tagging, longest time–at large in the Atlantic)	13-15 years	Atlantic: 15 years
Max. Size	450 cm (910 kg); common sizes in the northwestern Atlantic are 180-300 cm LJFL	280 cm (82 kg); common sizes are 150-180 cm LJFL	up to 230 cm LJFL	Atlantic: 455 cm (537 kg)
Natural Mortality	Assumed = 0.139	Range from 0.15 to 0.30	Range from 0.15 to 0.30	Assumed = 0.2

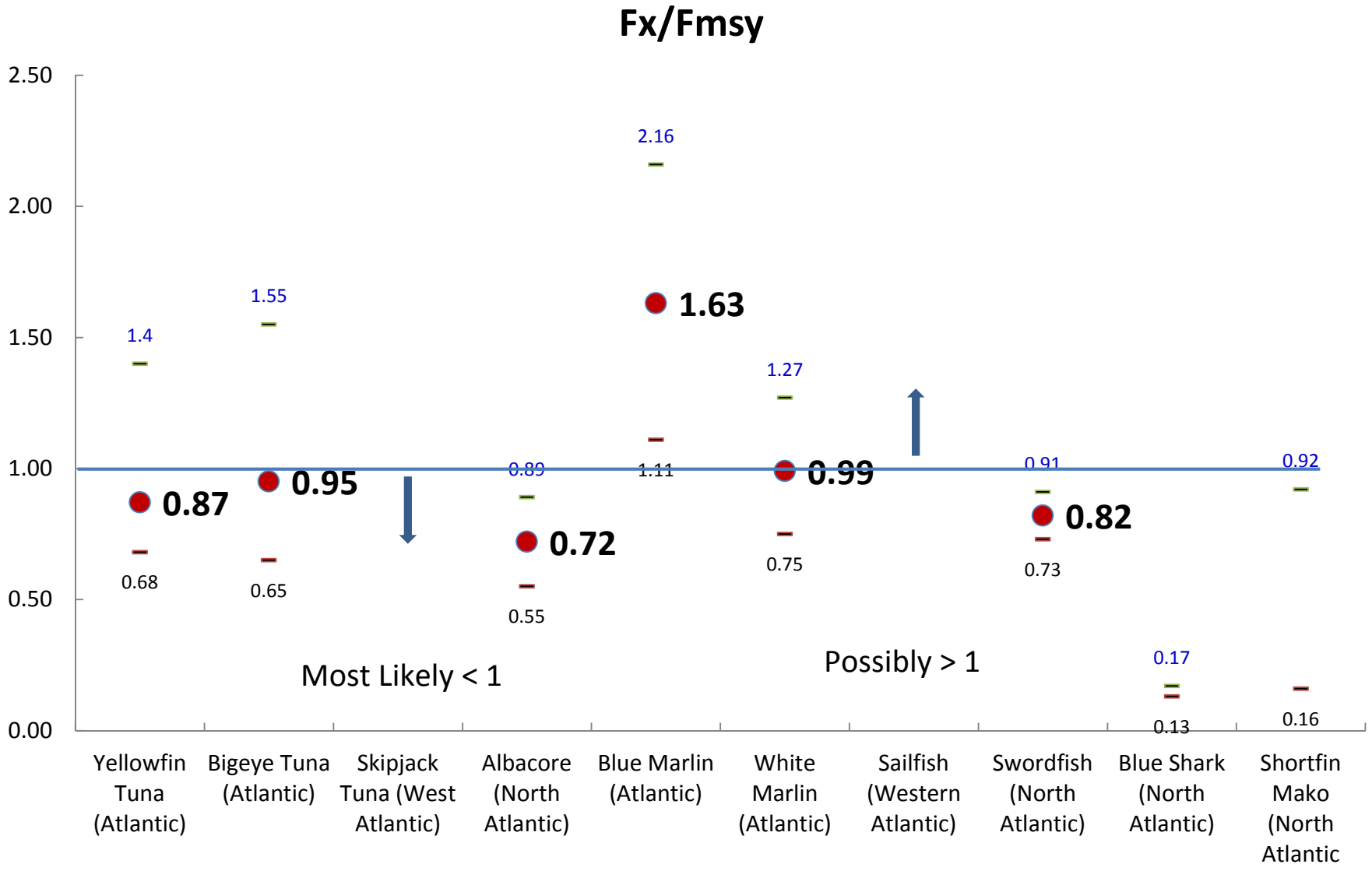
Source: ICCAT SCRS 2013 Report

STOCK STATUS



Source: ICCAT SCRS 2013 Report

STOCK STATUS



Source: ICCAT SCRS 2013 Report

STOCK STATUS

Species (Stock)	Year Last Assessed	MSY (t)	Min	Max	2012 Yield (t)	Status (Overfished)
Yellowfin Tuna (Atlantic)	2011	144,600	114,200	155,100	101,866	Yes
Bigeye Tuna (Atlantic)	2010	92,000	78,700	101,600	70,536	Yes
Skipjack Tuna (West Atlantic)	2008		30,000	36,000	33,200	No
Albacore (North Atlantic)	2013	31,680			26,237	Yes (Rec)
Blue Marlin (Atlantic)	2011	2,837	2343	3331	1,834	Yes
White Marlin (Atlantic)	2012		874	1604	403	Yes
Sailfish (Western Atlantic)	2009		600	1100	891*	Possibly
Swordfish (North Atlantic)	2013	13,660	13250	14080	13,972	No
Blue Shark (North Atlantic)	2008				36,131	No**
Shortfin Mako (North Atlantic	2012				4,488	No

* - Provisional; ** Highly Uncertain

Source: ICCAT SCRS 2013 Report

STOCK STATUS

Sharks: 2012 Ecological Risk Assessment on Atlantic stocks

Risk analysis to evaluate biological productivity and analysis to assess susceptibility to capture and mortality in pelagic longline fisheries

Stocks with lowest productivity were:
Bigeye thresher
Sandbar
Longfin mako
Night shark
South Atlantic Silky Shark

Most vulnerable stocks:
Bigeye thresher
Shortfin and Longfin mako
Porbeagle
Night Sharks

Source: ICCAT SCRS 2013 Report

MANAGEMENT

Effort controls:

YFT: Not to exceed 1992 level;

YFT & BET: Limit # LL and Purse seine boats for several countries; # Vessels limited to < avg. of 1991 and 1992; CPCs to authorize vessels > 20m LoA to fish in Convention Area

SKJ: None

ALB: fishing capacity limited to average of 1993 and 1995 levels

Total Allowable Catch:

YFT: 110,000 t (2013 onwards)

BET: 85,000 t (2013 – 2015)

SKJ: None

ALB: 28,000 t (2014 – 2016)

BUM: 2,000 t (2013 to 2015)

WHM: 400 t (2013 to 2015)

SAI: None

SWO: 13,700 t (2014 to 2016)

BUM & WHM: Annual amount harvested by pelagic longlines and purse seine vessels and retained for landing not more than 50% and 33% respectively of 1996 or 1999 landing levels, whichever is greater

Source: ICCAT SCRS 2013 Report

MANAGEMENT

Time/Area Closure:

YFT: surface fishing on FADs from African coast to 10° S , 5° W to 5° E, during Jan-Feb in the Gulf of Guinea

No purse seines and bait boat fishing during November in area 0°- 5° N; 10° - 20° W

BET: No fishing with natural or artificial floating objects during January or February in the area encompassed by the African coast, 10° S, 5°E and 5°W

Minimum Size Limit

BUM Recreational fishery - 251 cm LJFL

WHM Recreational fishery - 168 cm LJFL

SWO: 125 cm LJFL with a 15% tolerance, or 119 cm LJFL with zero tolerance and evaluation of the discards

Catch and Trade Restrictions

BUM and WHM caught in recreational fishery

Source: ICCAT SCRS 2013 Report

MANAGEMENT

Prohibition on retaining on board, commerce, etc.

SHARKS: Management recommendations, *inter alia*, prohibit vessels from retaining on board, transshipping, landing, storing, selling, or offering for sale any part or whole carcass of bigeye thresher sharks (*Alopias superciliosus* - ICCAT Rec. 09-07); oceanic whitetip sharks (*Carcharhinus longimanus* – ICCAT Rec 10-07); sharks of the family *Sphyrinidae* (except *Sphyrna tiburo* – Rec 10-08), silky sharks (*Carcharhinus falciformis* – ICCAT Rec. 11-08) and shark fins in general (ICCAT Rec 04-10).

Management Plans (Rec 11-01)…

FAD: *24. By 1 July of each year, CPCs with purse seine and baitboat vessels fishing for bigeye and yellowfin tunas in association with…FADs, shall submit to the Executive Secretary Management Plans for the use of such aggregating devices by vessels flying their flag, following the Guidelines for Preparation for FAD Management Plans suggested in Annex 2.*

SWO: Requirement to submit fishery development/management plans

Source: ICCAT SCRS 2013 Report

MANAGEMENT

ICCAT Recommendation 13-01 Amending the Recommendation on Multi-Annual Conservation and Management Program for Bigeye and Yellowfin Tunas

Stringent measures for collecting and reporting information on FAD fisheries (purse seine and bait boats) – deployment and loss of FAD, relevant details (FAD identifier, type, design characteristics)

CPCs to update data collection systems or introduce FAD-logbooks; report Task II data; report details on vessels using FADs, promote FADs which design can reduce the entanglement of sharks, marine turtles or any other species.

CPCs may defer implementation to the 1st of January 2015 provided that they collaborate with the Executive Secretary, ICCAT.

Source: ICCAT SCRS 2013 Report

CONCERNS

YFT: Younger age classes of YFT (40 to 80cm) exhibit a strong association with FADs (natural or artificial) - increases vulnerability to surface gears, and may have negative impacts on their biology and ecology due to changes in feeding and migratory behaviours.

BET: similar as for YFT

ALB: Despite current TAC other provisions of recommendations allow for catches to exceed this level.

BUM & WHM: significant increase in non-industrial fisheries catches - these fisheries are not fully accounted for in current database; concern over effectiveness of current TAC in light of severe under-reporting in some fisheries

WHM: status of stock due to misidentification of spearfish in white marlin catches

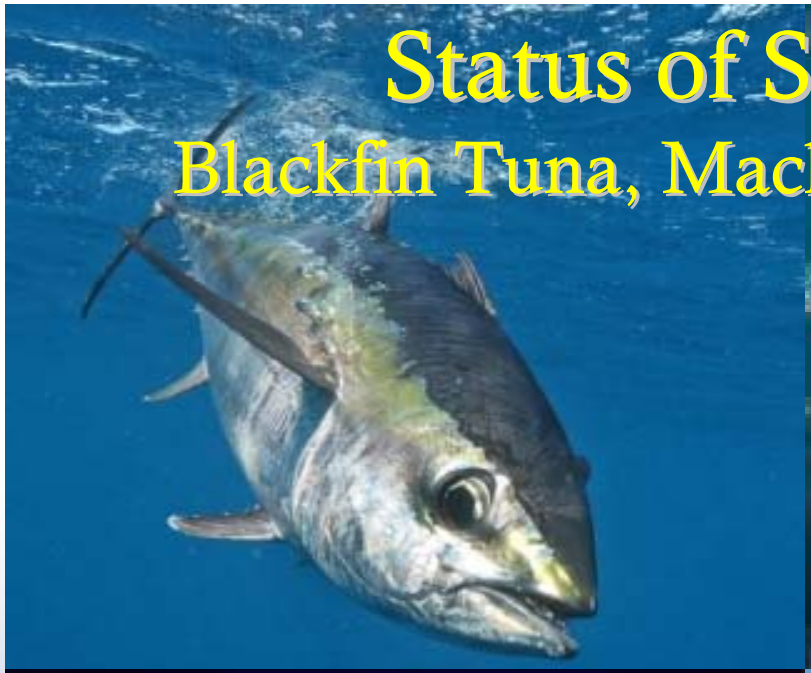
SAI: artisanal fishermen harvest a large part of the sailfish catch of the western stock; data limitations

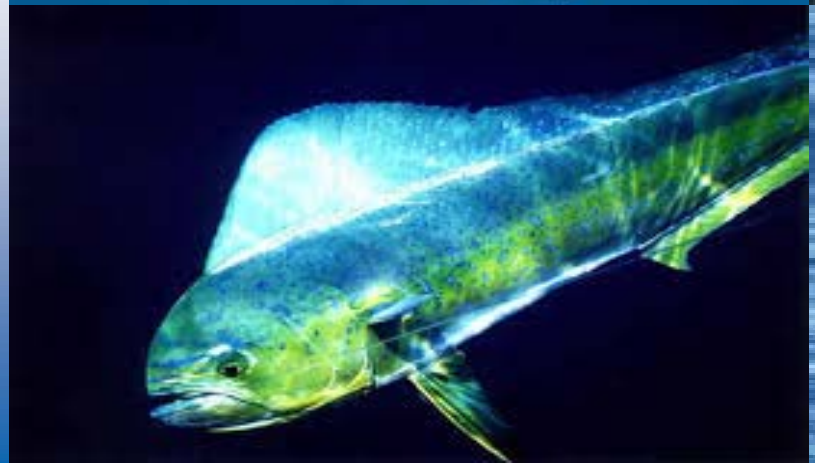
SWO: national regulations in some countries resulted in un-reporting of discarded fish in NA stock – implications for SA stock and future assessments

Source: ICCAT SCRS 2013 Report

Status of Stocks and Management

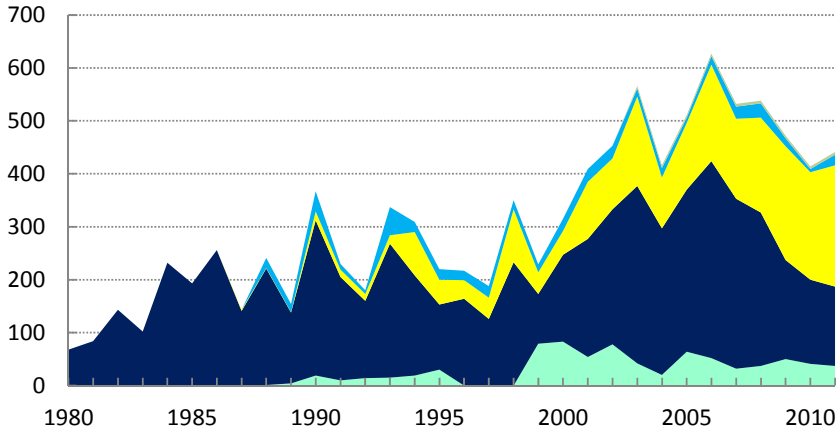
Blackfin Tuna, Mackerels, Dolphinfish, Flyingfish



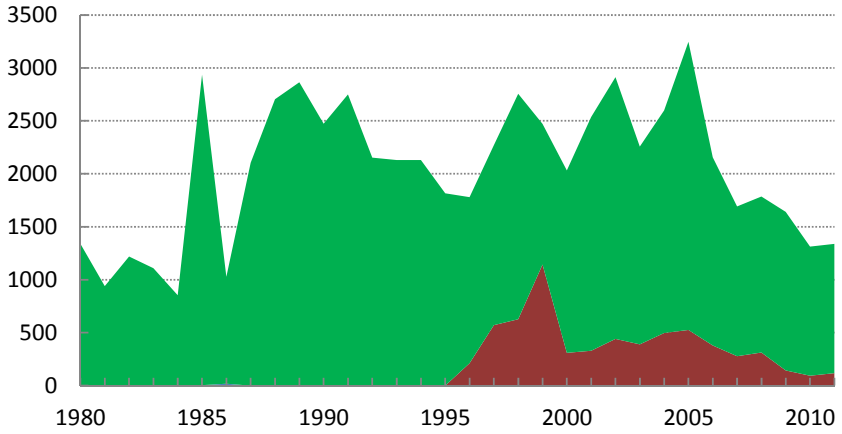


Estimated Catches (t) – 1980 to 2011
(Source: FAO FISHSTATJ)

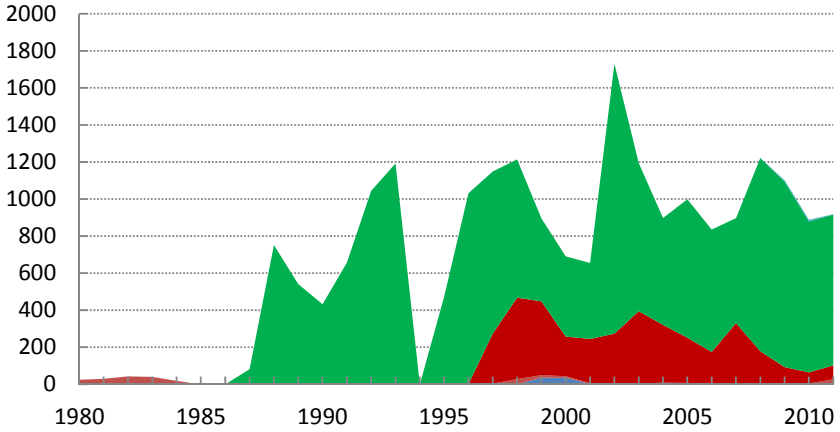
Blackfin Tuna



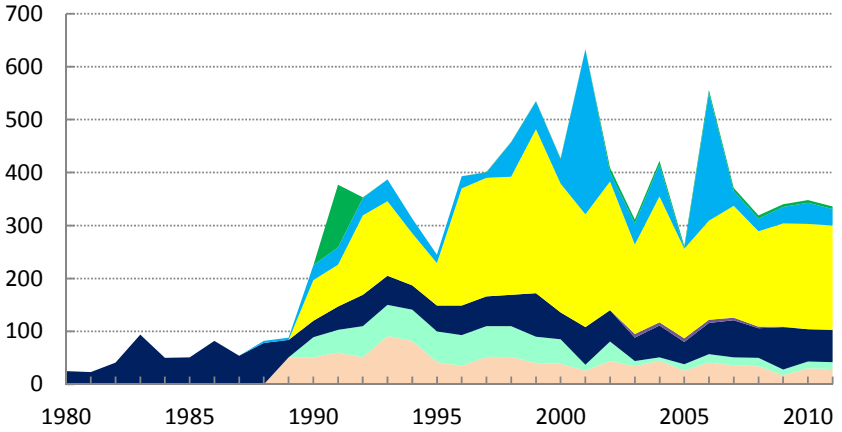
Serra Spanish Mackerel



King Mackerel



Wahoo



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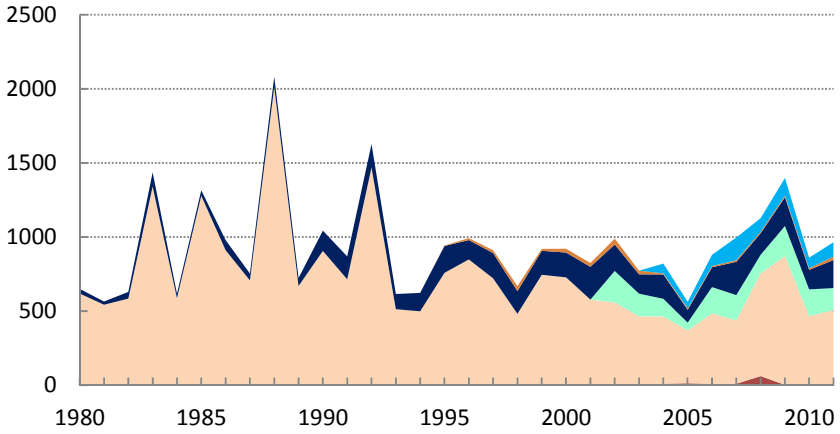
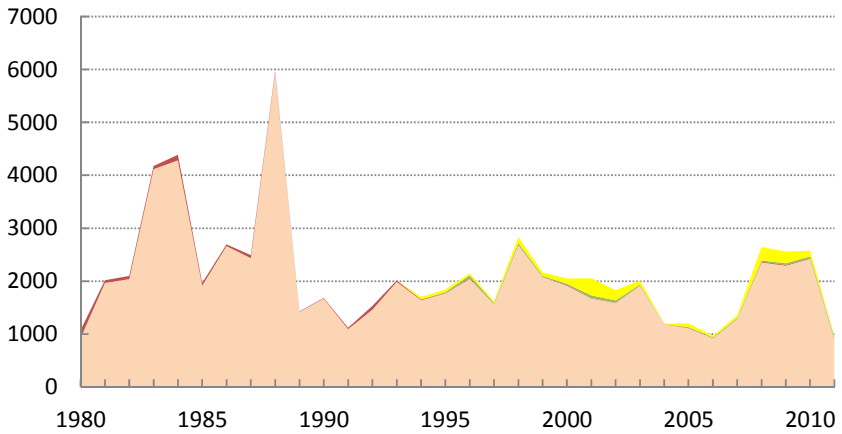
Estimated Catches (t) – 1980 to 2011
(Source: FAO FISHSTATJ)

Common Dolphinfish



Flyingfishes nei



SVG TT STL GRE DOM BAR GUY

BIOLOGY

Common Name	Blackfin Tuna	Serra Spanish Mackerel	King Mackerel
Scientific Name	*Thunnus atlanticus*	*Scomberomorus brasiliensis*	*Scomberomorus cavalla*
Distribution	highly migratory, epipelagic - found over reefs, bays and offshore, confined to coastal waters warmer than 20°C; believed to occur only in western Atlantic from Massachussets to Rio de Janeiro, Caribbean and Gulf of Mexico	Western Atlantic: along the Caribbean and Atlantic coasts of Central and South America from Belize to Rio Grande do Sul, Brazil - does not migrate extensively, although some seasonal movement appears to occur off Trinidad.	the western Atlantic from Massachusetts, USA to Rio de Janeiro, Brazil; also reported in the mid Atlantic at St Paul's Rocks
Spawning Grounds	distinct spawning grounds throughout range; in Caribbean possibly between April and September, possible breeding ground in Lesser Antilles around May-June	? Spawning in Gulf of Paria, Trinidad, year round	western Gulf of Mexico (May to Sept); NE Caribbean (Apr to Sept); Trinidad and NE Brazil (year round; peaks Oct to Mar)
Maturity	Around 2 years (40 to 50 cm FL)	41.9; 42.3 cm FL (female; male – NE Brazil)	1-2 years
Life Span	Around 5 years		7-10 years (m,f; Trinidad); 14 years (Brazil)
Max. Size	110 cm FL	125 cm	184 cm TL
Natural Mortality			0.51 – 0.59

BIOLOGY

Common Name	Wahoo	Common Dolphinfish	Four-wing Flyingfish
Scientific Name	*Acanthocybium solandri*	*Coryphaena hippurus*	*Hirundicthys affinis*
Distribution	circum-tropical; tropical and subtropical waters of Atlantic; including Mediterranean and Caribbean Seas, Pacific and Indian Oceans; seasonally may extend to temperate waters. In WCA extends from NE Brazil to Rhode Island, USA	highly-migratory pelagic species, in tropical and sub-tropical oceanic waters worldwide, bounded in N and S by 20°C isotherm. In WA ranges from Nova Scotia to Rio de Janeiro but most common from North Carolina, throughout Gulf of Mexico, Caribbean to NE coast of Brazil	: Eastern Atlantic: Guinea to Angola. Western Atlantic: Gulf Stream off Virginia, USA and northern Gulf of Mexico to northern Brazil, including the Caribbean Sea. Northwest Atlantic: Canada. Indo-Pacific: Arabian Sea.
Spawning Grounds	N. Gulf of Mexico – May to Aug (peak in June); N. Carolina – June to Aug (peak in June/July), Bermuda – May to Aug		In Eastern Caribbean – seasonal from November to June, peak spawning Nov-Jan and Apr –May; tagging studies and LEK suggest that shelf off NW Tobago may be a preferred spawning location.
Maturity	1 year; 86 to 101 cm TL (males and females considered)	3.5 - 7 months (40 - 73.5 cm)[3]	18 – 20.3 cm FL (5 – 7 months)
Life Span	5-6 years; possibly extending to 10 years	12 - 18 months (Southern Caribbean)[2]	18 months
Max. Size	250 cm TL	210 cm TL[3]	23 cm FL
Natural Mortality	uncertain – estimates are 0.38 – 0.44; 0.47	0.66, 2.56, High Uncertainty	Highly uncertain – but likely to be high

STOCK STATUS & Management

Blackfin Tuna

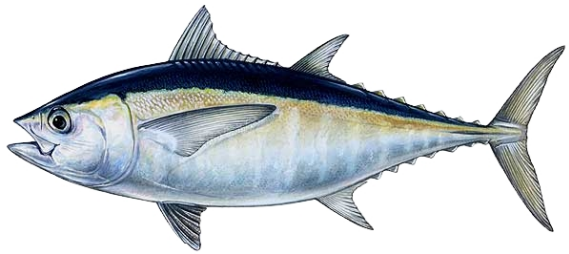
2010: Review of available data - catch, catch rate, stock structure, biology (Neilson, J. and Minte-Vera, C.V.)

2011: Standardization of catch rates – Saint Lucia;
Paper (pres.) - Martinique and Guadeloupe Fleets targeting Dolphinfish, Flyingfish and Blackfin Tuna (L. Reynal);
Paper presented on Blackfin tuna catch, catch rates and size structure of Venezuelan fisheries (Arocha, F.)

2012: CRFM – draft sub-regional management plan developed; Detailed review of biology and country summaries of data collection systems, available data, estimation of total landings and recommendations for improved data coverage (St Vincent, Grenada, Dominica, Saint Lucia); Standardization of catch rates – Saint Lucia;

Status: No evidence that overfishing is occurring

Management: Currently no measures in effect.



Recommendations:
Catch levels should not be allowed to increase beyond current levels given concerns as regards impacts of recent catch increases likely due to FAD fishing and improvements in data collection

Source: CRFM Sci. Meet. – Theophile et al., 2012

STOCK STATUS & Management

Serra Spanish Mackerel

2005 - Surplus production model (Trinidad - catch data from 1972 to 1991; 1995 to 2002; gillnet effort data; ICCAT landings data for 1977 to 2002)

Status: Overall, results inconclusive - conflicting results from runs with B1977 estimated and fixed; status sensitive to estimates of catches, and starting biomass level for which there is great uncertainty.

Management: Current measures in T&T include **mesh size restrictions** on gillnets and limitations in net dimensions as well as a size **limit** of 30.5 cm (12 inches) which may not be taken, sold or exposed for sale.

Recommendations:
Maintaining the status quo will be ok in the short-medium term but will be problematic in the long-term. Maintaining fishing mortality at 0.75 Fmsy would result in short term sacrifices and under-performance within next 10 years, but more sustainable in the long term.

Source: CRFM Sci. Meet. – Martin and Nowlis, 2005

King Mackerel

2006 & 2007:Length frequency analysis (Trinidad - 2006-2007) and Analytical Yield Per Recruit Model – Southern stock assumed – shared among Trinidad and Tobago, Venezuela and Guyana – recognized catches in Brazil and Grenada may be from same stock and so stock range may be incompletely defined.

Status: Overall, results inconclusive - status of the stock as measured by the target reference point (F0.1) and limit reference point (F20%SPR) varies greatly depending on growth/natural mortality parameter combination used in the analysis.

Management:
TT: current measures same as for Serra Spanish Mackerel
STL: recreational fishery – gear restrictions - limit number of fish caught – 18 King Mackerel, Dolphin and Wahoo

Recommendations:
Precautionary Approach - current levels of fishing effort should not be increased

Source: CRFM Sci. Meet. – Parker et al., 2005 and 2007

STOCK STATUS & Management

Wahoo

2005 & 2007 - Non-equilibrium, surplus production model and length frequency analyses, catch and catch rate analyses - (2005 - Barbados, Dominica, Grenada, Saint Lucia, St Vincent; 2007 with data from 1994 to 2003 - Barbados and Saint Lucia with data for 1996 to 2006)

MSY (t): Assumed as peak catches taken in 1997 - 1999 (1400 - 1600 t)

Status: No declines in CPUE between 1995 and 2003; Local abundance of stock sustainable at 1996 - 2006 harvest levels, at least in the short term.

Management: Currently there are no management measures in effect except for recreational fishery in STL

Recommendations:
Precautionary Approach - no large increases in fishing pressure recommended until stock dynamics are better understood.

Source: CRFM Sci. Meet. – Parker et al., 2005 and 2007

Dolphinfish

2010- Catch and Catch Rate Analyses (Barbados, Saint Lucia, St Vincent - 1994 to 2010)

Yield: 1,200 t (2009 for EC countries)

Status: no evidence of decline in stock abundance over the period; current levels of harvest probably sustainable

Management: Currently there are no management measures in effect except for recreational fishery in STL

Recommendations:
Due to uncertainties in assessment, cannot make predictions on long-term stock sustainability – suggest precautionary approach to management – no further development until the stock structure and dynamics are better understood

Source: CRFM Sci. Meet. – Parker, 2010

Ecological Risk Assessment: Large Pelagic Fisheries

CRFM Secretariat & CLME

2011 – 2012 – to assess relative risks to target, by-catch and threatened, endangered or protected species that could be impacted by pelagic fisheries.

Of 39 species considered, 18 target species were found to have low vulnerability to hazards identified and 21 had medium vulnerability (most being low-priority target species).

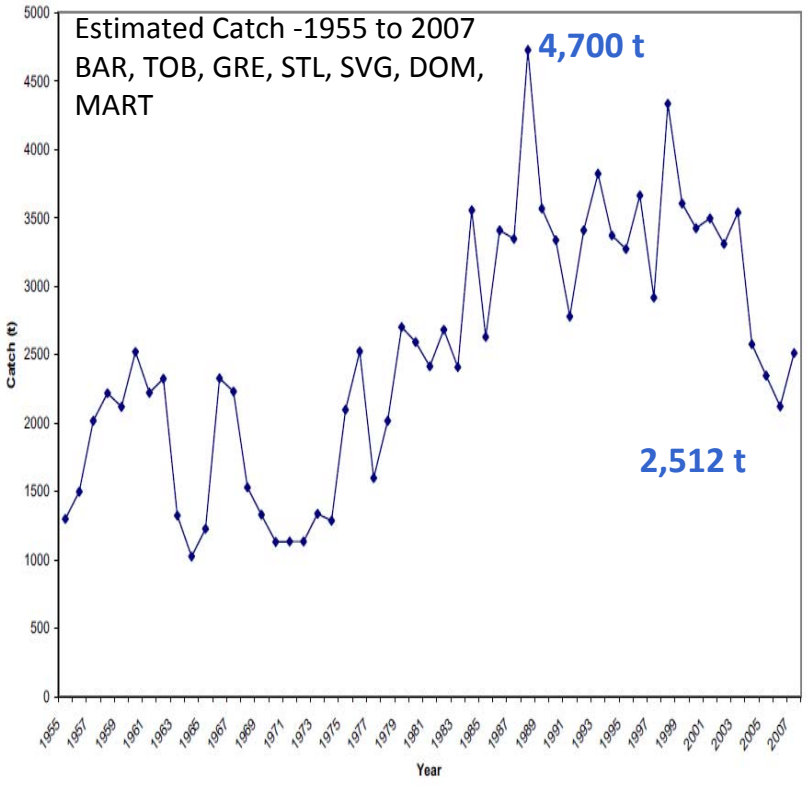
Conclusion: Full use of ERAEF requires investment in broader level monitoring and partnerships with research institutes and other sectors of government.

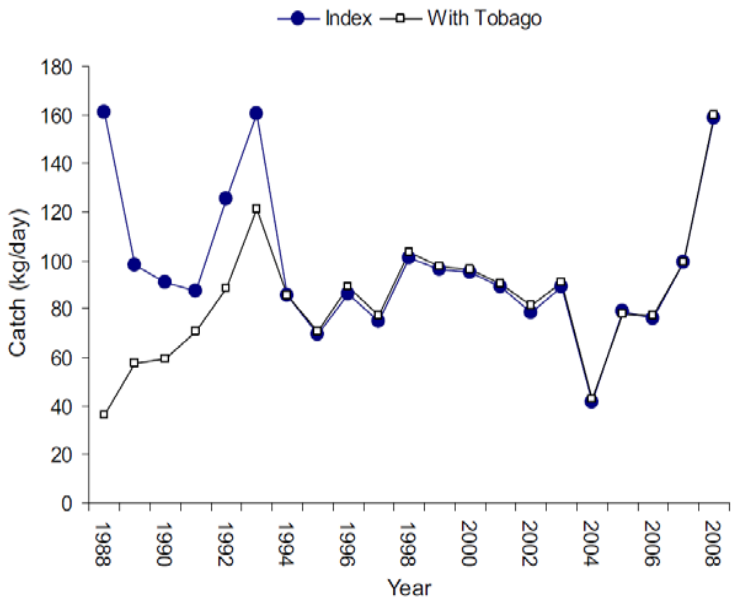
Source: Proudfoot and Singh-Renton, 2012

STOCK STATUS & Management

Fourwing Flyingfish (FAO Ad-Hoc WG)

2008 - Stock Recruitment Model and Risk Assessment; Catch and Catch Rate Analyses (C - all countries; CPUE - Barbados, Saint Lucia, Tobago)





Source: 3rd Meet. of FAO Ad-Hoc WG on Flyingfish – Medley et al., 2010

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Fourwing Flyingfish

	0.05	Median	0.95
R0	1.72	3.40	10.51
Unexploited biomass (tonnes)	10 870	26 351	131 428
Biomass 2007 (tonnes)	10 011	25 919	131 306
MSY (tonnes)	3 312	7 897	36 291
2007 yield (tonnes)		2 512	
B/B_{MSY}	1.97	2.71	4.17
F/F_{MSY}	0.03	0.17	0.50

Concerns:

Poor quality data; model & assessment not fully tested; no sensitivity analyses; need for rigorous testing to ensure management advice provided is sound.

Source: 3rd Meet. of FAO Ad-Hoc WG on Flyingfish – Medley et al., 2010

Status: not overfished and there is no overfishing at regional level (could not determine whether or not there are local depletions)

Management: Currently there are no management measures in effect. Draft Sub-Regional Management Plan (FAP, CLME, CRFM) – to be endorsed by Ministerial Sub-Committee

Recommendations: No measures recommended at the time. Catch trigger 5,000 t advised (max. annual catch est at 4,700t) - management measures required to safeguard against overfishing if catches approach trigger point - a freeze in development suggested until stock is reassessed and management measures adjusted accordingly

CRFM Secretariat & CLME

Evaluate multi-criteria analysis – improving information in multi-objective decision analysis in FF fishery.

Source: Campbell and Singh-Renton, 2012

Trophic Analysis
Lesser Antilles Pelagic Ecosystem

FAO Project - Scientific Basis for Ecosystem-Based Management in the Lesser Antilles including Interactions with Marine Mammals and Other Top Predators and used to quantify abundance, fishing and natural mortality and trophic linkages among species or species groups in the pelagic ecosystem and to examine possible policy options for management of the respective fisheries.

Results suggested that prey availability is a stronger factor in the dolphinfish-flyingfish dynamics (dolphinfish being a key predator of flyingfish) than predator control.

Unexpected trophic interaction between yellowfin tuna and skipjack tuna as a consequence of yellowfin tuna feeding on skipjack and skipjack in turn feeding on yellowfin juveniles.

Skipjack tuna, controls the recovery of its own key predator.

Source: Mohammed et al., 2008 FAO Pub.

Summary

Species		Overfished
	Yellowfin Tuna	Yes
	Bigeye Tuna	Yes
	Skipjack Tuna	No
	Albacore	Yes (recovery in progress)
	Blue Marlin	Yes
	White Marlin	Yes (recovery in progress)
	Sailfish	Possibly
	Swordfish	No
	Shortfin Mako	No
	Blue Shark	No
	Blackfin Tuna	Possibly not at local level
	Serra Spanish Mackerel	Possibly
	King Mackerel	Possibly
	Wahoo	Possibly not at local level
	Dolphinfish	Possibly not at local level
	Fourwing Flyingfish	Not at regional scale

Statistics and Research Recommendations

1. Need for **policy/decision-makers to guide scientists** – management objectives must be clear and measurable

2. Need to **delineate stocks** so as to identify those countries which must be included in assessment and management efforts [currently IFREMER (Martinique), Venezuela and the USA participate in CRFM Annual Scientific Meetings]

3. Need to **collect data to facilitate improved quality of assessments and management** advice provided:

- better data collection protocols and analysis – validation/verification
- estimate of all removals from fishing – total catch
- better estimate of fishing effort
- historical time series data of catch and effort
- improve biological parameter estimates- age; growth; natural mortality
- identify minimum data collection standards that can be sustained with given resources

Statistics and Research Recommendations

5. Research on ecological impacts of fishing - FAD fishing – changes in species composition, diet, abundance etc.

6. Research – technological, behavioural change or other measures to reduce catches of juvenile fish

7. Licensing systems – limited entry – based on what management objective and information?

   Resource sustainability

   Conflict avoidance

   Maintained profitability

   Fishing effort data important - to equate fishing mortality with number of boats – give management advice that is relevant for limited-entry system

8. Social and Economic importance of FAD fisheries