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8.1 YFT – YELLOWFIN TUNA

The last assessment for yellowfin tuna was conducted in 2003, at which time catch and effort data through 2001 were available. This report includes the latest data available on catches and the fisheries and focuses on changes that may have taken place since the last assessment. Readers interested in a more complete summary of the state of knowledge on yellowfin tuna should consult the detailed report of the 2003 ICCAT Atlantic Yellowfin Tuna Stock Assessment Session (Anon. 2004).

Other information relevant to yellowfin tuna is presented elsewhere in this SCRS Report:

- The Tropical Tunas Work Plan **(Appendix 5)** includes plans to address research and assessment needs for yellowfin tuna.
- Report of the *2007 Inter-sessional Meeting of the Tropical Species Working Group* (SCRS/2007/012).

The Report of the *Tropical Species Working Group Meeting* (Madrid, September 27-28, 2007) is found in SCRS/2007/XXX.

YFT-1. Biology

Yellowfin tuna is a cosmopolitan species distributed mainly in the tropical and subtropical oceanic waters of the three oceans. The sizes exploited range from 30 cm to 170 cm FL; maturity occurs at about 100 cm FL. Smaller fish (juveniles) form mixed schools with skipjack and juvenile bigeye, and are mainly limited to surface waters, while larger fish form schools in surface and sub-surface waters. Reproductive output among females has been shown to be highly variable. The main spawning ground is the equatorial zone of the Gulf of Guinea, with spawning primarily occurring from January to April. Juveniles are generally found in coastal waters off Africa. In addition, spawning occurs in the Gulf of Mexico, in the southeastern Caribbean Sea, and off Cape Verde, although the relative importance of these spawning grounds is unknown. Although such separate spawning areas might imply separate stocks or substantial heterogeneity in the distribution of yellowfin tuna, a single stock for the entire Atlantic is assumed as a working hypothesis, taking into account the transatlantic migration (from west to east) indicated by tagging, a 40-year time series of longline catch data that indicates yellowfin are distributed continuously throughout the entire tropical Atlantic Ocean, and other information (e.g., time-area size frequency distributions and locations of fishing grounds). Growth rates have been described as relatively slow initially, increasing at the time the fish leave the nursery grounds. Males are predominant in the catches of larger sized fish. Natural mortality is assumed to be higher for juveniles than for adults; this is supported by tagging studies for Pacific yellowfin.

Questions remain concerning the most appropriate growth model for Atlantic yellowfin tuna. A recent study developed a new growth curve using daily growth increment counts from otoliths. The results of this study, along with other recent hard part analyses, do not support the concept of the two-stanza growth model (initial slow growth) which is currently used for ICCAT yellowfin tuna stock assessments and was developed from length frequency and tagging data. This discrepancy in growth models should be resolved prior to, or accounted for during, future stock assessments.

New information on sizes, sex ratio, and catch rates of yellowfin tuna was presented for the western south Atlantic from the Observer Program of Uruguay. The results indicated that higher catch rates of larger (adult) fish occurred further offshore, are associated with warmer temperature waters, and show seasonal patterns.

YFT-2. Fishery indicators

In contrast to the increasing catches of yellowfin tuna in other oceans worldwide, there has been a steady decline in overall Atlantic catches since 2001. Atlantic surface fishery catches have shown a declining trend from 2001 to 2006, whereas longline catches increased within that period until 2004, then began to decline as well In the eastern Atlantic, purse seine catches declined from 94,221 t in 2001 to 55,570 t in 2006, a 41% reduction **(YFT-Table 1; YFT-Figure 1)**. Baitboat catches declined by 45%, from 19,071 t to 10,434 t. This decrease is largely due to reduced catches by Ghana baitboats, which resulted from a combination of reduced days fishing, a lower number of operational vessels, and the observance of the moratorium on fishing using floating objects. In the western Atlantic, purse seine catches have nearly disappeared, declining from 13,072 t to 13 t. Baitboat catches declined by 49%, from 5,315 t to 2,695 t. In the eastern Atlantic, longline catches increased from 5,479 t to 11,428 t in 2004, before declining again to 5,808, a 6% increase from 2001. In the western Atlantic, longline catches increased slightly (5%) from 12,740 t to 12,984 t. The increase in South African catches in the eastern Atlantic during 2005 and 2006 may be the result of a spillover of Indian Ocean fish caught just inside the Atlantic boundary. The most recent available catch distribution is given in **YFT-Figure 2**.

At the same time, the nominal effort in the purse seine fishery was declining. As an indicator, the number of purse seiners from the European and associated fleet operating in the Atlantic declined from 44 vessels in 2001 to 24 vessels in 2006, with an average age of about 25 years. On the other hand, the European and associated baitboat fleet increased from 15 to 17 vessels during the same period.

Several relevant scientific documents were presented to the 2006 and 2007 SCRS which were descriptive of the catches by country fleets. Examination of nominal catch rate trends from purse seine data suggest that catch-per-unit effort was stable or increasing in the East Atlantic **(YFT-Figure 3a)**, and was clearly declining in the West Atlantic **(YFT-Figure 3b)**. If effort efficiency is estimated to have continued to increase as has been assumed in the past, adjustments for such efficiency change would be expected to result in a steeper declining trend. However, the decrease in western Atlantic purse seine catch rates could be linked to specific environmental conditions (e.g. high surface temperatures, reduced availability of prey, etc.), especially considering that decreases are also seen in skipjack catch rates, and it is therefore difficult to conclude that these rates reflect abundance trends. New information on fisheries targeting yellowfin tuna of the southwestern Atlantic was presented for Uruguayan fleets, including catch, effort, and CPUE from 1981 through 2006. Standardized catch rates were provided in 2006 for the Japanese and Chinese Taipei longline fishery, but data for 2006 are not yet available. New standardized indices were made available for the Brazilian (through 2005) and United States (through 2006) longline fleets. These indices are compared in **YFT-Figure 4**. The Chinese Taipei index is not shown prior to 1992 in order to avoid a period of shifting targets (from albacore) which is not adequately accounted for in the standardization. The overall trend of the major index shown, Japanese longline, is clearly one of decline, but there is not clear trend in the four years since 2001, the latest data included in the last assessment.

The average weight trends by fleet (1970-2005) are shown in **YFT-Figure 5.** The recent average weight in European purse seine catches, which represent the majority of the landings, has declined to less than half of the average weight of the early 1990s. This decline is at least in part due to changes in selectivity associated with fishing on floating objects. This trend is also reflected in eastern tropical baitboat catches. Longline mean weights have also followed a generally declining trend, although estimates have been highly variable in recent years.

YFT-3. State of the stock

A full assessment was conducted for yellowfin tuna in 2003 applying various age-structured and production models to the available catch data through 2001. The estimate of MSY based upon the equilibrium models ranged from 151,300 to 161,300 t; the estimates of F_{2001}/F_{MSY} ranged from 0.87 to 1.29. The point estimates of MSY based upon the non-equilibrium models ranged from 147,200-148,300 t. The point estimates for F_{2001}/F_{MSY} ranged from 1.02 to 1.46; the main differences in the results were related to the assumptions of each model. The estimate of MSY derived from age-structured virtual population analysis (VPA) was 148,200 t. In summary, these analyses implied that although the 2001 catches of 159,000 t (since revised to 163,000 t) were slightly higher than MSY levels, effective effort may have been either slightly below or above (up to 46%) the MSY level, depending on the assumptions. Yield-per-recruit analyses provided similar estimates of fishing mortality rates and further indicated that an increase in effort was likely to decrease the yield-per-recruit, while reductions in fishing mortality on fish less than 3.2 kg could result in substantial gains in yield-per-recruit and modest gains in spawning biomass-per-recruit.

Since the relatively high catch levels of 2001 (163,000 t), catches have declined each year to a level of 99,500 t, a reduction of 39% and the lowest level of catch since 1973. A potential explanation for this decline is the reduction in eastern Atlantic purse seine effort, but that alone does not explain the reduction of catches of baitboat and of purse seine in the western Atlantic, nor the more recent declines of longline catches in both the western and eastern Atlantic. Until a full assessment is conducted, it may not be possible to confirm whether catch declines are due to stock level declines or to reduction in effort or other factors. Declines in catch rates could suggest decreases in abundance or availability, and a clear picture does not emerge from the available fishery indicators.

Yearly catches of small (less than 3.2 kg) yellowfin tuna in number have ranged around 60-75% of purse seine catches and about 40-80% of baitboat catches since 2000, occurring primarily in the equatorial fisheries. The generally declining trends in average weight may also be a cause for concern. Minimum size limits for yellowfin tuna have been shown to be ineffective by themselves, due to difficulties related to the multi-species nature of the fishery. The protection of juvenile tunas may be important and alternative approaches to minimum size regulations to accomplish this should be studied.

YFT-4. Effects of current regulations

Recommendation 04-01 implemented a new, smaller closure for the surface fishing in the area 0º -5º N, 10º W-20º W during November in the Gulf of Guinea. Although this regulation is intended to reduce small bigeye catches, the Committee recognizes that its implementation and the change from the previous moratorium to the current regulation will potentially impact yellowfin catches. There are as yet insufficient data to effect an evaluation of the impact of the new regulation.

In 1993, the Commission recommended "that there be no increase in the level of effective fishing effort exerted on Atlantic yellowfin tuna, over the level observed in 1992." As measured by fishing mortality estimates from the 2003 assessment, effective effort in 2001 appeared to be approaching or exceeding the 1992 levels. Catches have been declining since 2001, as has the nominal effort of the purse seiners, but the trend in effective effort is not clear. Additional advice can be offered following the next stock assessment (2008).

ATLANTIC YELLOWFIN TUNA SUMMARY

Maximum Sustainable Yield (MSY)[1]	~148,000 t
Current Yield [2] (2006)	99,485 t
Replacement Yield (2001)	May be somewhat below 159,000 t
Relative Biomass B_{2001}/B_{MSY}[3]	0.73 - 1.10
Relative Fishing Mortality: F_{2001}/F_{MSY}[3]	0.87-1.46
F_{99-01}/F_{MSY}[4]	1.13 (80% confidence limits 0.94 to 1.38)
$F_{0.1}$[4]	0.55
F_{MSY}[4]	0.72

Management measures in effect:
- Effective fishing effort not to exceed 1992 level [Rec. 93-04].
- Rec. 04- 01, effective 2005. Season/area closure. Although this measure was intended to reduce the catches of juvenile bigeye tuna, as this is a complete closure, impacts are expected on all tropical tunas.

[1] MSY estimates based upon results of age-structured and non-equilibrium production models, and VPA. The complete range of results from all models is 147,200-161,300 t.
[2] The assessment was conducted using the available catch data through 2001. Reports for 2006 should be considered provisional.
[3] These are ranges of point estimates; no estimates of uncertainty were calculated around these point estimates during the assessment.
[4] Result exclusively from VPA and yield-per-recruit analyses.