

**CATCH ESTIMATES OF YELLOWFIN TUNA, *Thunnus albacares*, IN THE 1987-1994
U.S. ATLANTIC AND GULF OF MEXICO ROD AND REEL FISHERIES**

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SUMMARY

Rod and reel catch estimates for yellowfin tuna off the southern and eastern coasts of the United States (excluding Texas) were developed using data obtained from two separate surveys of anglers. The Large Pelagic Survey, conducted annually from North Carolina through Maine during June-October, specifically targets fishing effort directed at large pelagic fish such as tunas. Data concerning fishing activity outside of the time-area coverage of the Large Pelagic Survey were collected through the Marine Recreational Fishery Statistics Survey, which targets all marine recreational fishing effort.

RESUMÉ

On a estimé les captures d'albacore effectuées à la canne/moulinet au large des côtes sud et est des Etats-Unis (Texas excepté) au moyen de données obtenues par deux enquêtes distinctes auprès des pêcheurs. La "Large Pelagic Survey", menée tous les ans de la Caroline du Nord au Maine de juin à octobre cerne spécifiquement l'effort visant les grands pélagiques tels que les thonidés. Les données sur les activités de pêche non couvertes par la "Large Pelagic Survey" ont été recueillies à travers la "Marine Recreational Fishery Statistics Survey" qui suit l'ensemble de l'effort de pêche sportif portant sur les espèces marines.

RESUMEN

Se desarrollaron estimaciones de captura de caña y carrete para rabil frente a las costas sur y este de Estados Unidos (excluyendo Texas), empleando datos obtenidos de dos prospecciones separadas de pescadores deportivos. La Large Pelagic Survey, que se lleva a cabo anualmente desde North Carolina hasta Maine durante junio-octubre, busca específicamente el esfuerzo de pesca dirigido a los grandes peces pelágicos, tales como los túnidos. Los datos concernientes a la actividad pesquera exterior a la cobertura espacio-temporal de Large Pelagic Survey se recolectaron a través de Marine Recreational Fishery Statistics Survey, que busca toda clase de esfuerzo pesquero deportivo marino.

Introduction

The estimation of recreational rod and reel catches is usually more difficult than the estimation of commercial landings. Unlike landings of most commercial fishery gears, recreational rod and reel catches generally are not processed through seafood dealers (a major source of landings statistics). Furthermore, the universe of recreational fishermen is much larger than that of the commercial sector. In combination, these factors make censusing this catch much less likely than for commercial gears. For recreational rod and reel catches, statistically based surveys of catch and effort must be conducted to enable the estimation of landings.

Data were obtained from several surveys which sample rod and reel effort targeting large pelagic game fish off the Atlantic coast of the United States. Using data obtained during interviews of anglers in recent years, estimates of the number of fish landed ("kept") were developed for yellowfin tuna (*Thunnus albacares*).

Methods

Data were analyzed from two surveys:

Large Pelagic Survey (LPS)

A survey of the rod & reel/handline fishery operating from Hatteras Inlet, North Carolina (NC) through Maine is conducted annually during the months of May - October (Table 1), although coverage is sparse north of Massachusetts (MA). Sampling began for some areas in 1980; however, due to changes in survey design and coverage as well as the cooperative nature of a survey conducted by multiple agencies, complete data is only available for a portion of the areas and years covered. A detailed description of the agencies involved in data collection, methods of collection and variabilities in data elements recorded in early years can be found in Turner et al. (1992). The goals of this survey include weekly and annual catch estimation for a variety of large pelagic species, the sampling of sizes and other biological information, and the construction of annual indices of abundance (Brown and Huang 1994). In order to estimate catch, information is gathered on effort levels, catch rates, and fleet sizes.

Weekly telephone sampling from a list of boats known to be active in the fishery provides effort and catch rate data. Additional catch rate data and biological information are obtained by sampling trips as boats return to the docks or ramps. Each trip interview record includes data on: target species, date, boat type (private/charter), interview type (same day dockside or recall telephone), tournament participation, number and species of fish caught (kept/released alive/released dead) and, in many cases, size information. An estimate of fleet size is derived after interviewing fishermen at access points such as ramps and gas docks. Methodologies similar to the "mark-recapture" techniques employed with fish populations are used to estimate the number of private and charter boats operating in the fishery.

A stochastic simulation model of the fishery was created using this empirical data on fleet size and individual boat levels of effort and catch. The final outputs from the simulation model include estimates of number of fish caught for each species, both kept and released. These estimates are calculated within appropriate strata, such as time, area and boat type (charter/private) and are presented with a likelihood distribution (confidence limits) around a median point.

Areas are defined by state boundaries with the exceptions of Maryland-Delaware (MD/DE) and Connecticut-Rhode Island (CT/RJ) which are combined. Estimates of the number of fish caught are multiplied by the average weight of fish (converted from measured lengths) observed during dockside intercepts to obtain yield estimates.

Since data are not available for all areas for the entire time period (1987-1994), LPS catch estimates by themselves may not reflect the total catch in the region (NC-MA) from year to year. North Carolina was not covered by LPS until 1992 and sampling there is only conducted from Hatteras Inlet north. Estimates could not be made for VA in 1987 nor in New Jersey (NJ) in 1988 due to data unavailability; therefore, the estimates presented have been obtained using supplemental data or estimates provided by personnel within those states.

Fleet size estimates for 1994 have not been finalized, therefore catch estimates should be considered preliminary. Although the direction of any change is not certain, expectations are that revised fleet and, consequently, catch estimates for 1994 may be lower.

Marine Recreational Fishery Statistics Survey (MRFSS)

This survey, which is designed to sample all marine recreational fishing, is described in detail by Van Vorhees *et al.* 1992. Coverage includes the U.S. Atlantic and Gulf of Mexico coasts (excluding Texas) during the entire year. Therefore, LPS survey times and areas are also covered by the MRFSS. Tournament and party (head) boat fishing are not covered by MRFSS.

Inshore, offshore and shore-based (beach, piers, etc.) recreational fishing are divided into three modes: 1) shore, 2) private/rental boats and 3) charter boats. Within each mode, individual fishermen are interviewed about catch upon the conclusion of their trips. These interviews take place at specific access sites, with sampling effort proportional to fishing activity level. The catch information collected includes data on mode, number and species of fish caught (kept/released alive/released dead) and size information. Fishermen are also asked if they reside in the coastal county where the interview is taking place, elsewhere in the same state or outside of the state.

Effort data are gathered over the telephone using random digit dialing targeting coastal counties. Respondents are asked about effort within each mode during past two months. This effort is expanded to total fisherman-trips for the county based upon county population. Total effort for the state is expanded using ratios (of state fishermen living in and out of the coastal county) observed in the field intercepts; total effort for out-of-state fishermen is also expanded based upon ratios observed in the field.

Catch estimates, stratified by area, two month wave and mode (charter/private/shore) and with ranges of uncertainty, are calculated by multiplying catch rates from the field sampling by the appropriate effort. Yield estimates are obtained using the size information collected in the field.

Data for 1993 and 1994 are being reviewed to determine if some private/rental mode or party boat effort has been misclassified as charter effort. If so, revised estimates for those years may be different from what is presented here.

Results and Discussion

Estimated numbers of fish kept are shown in Table 2 for each area within the LPS region from North Carolina (NC) through Massachusetts (MA) for 1987-1994. These values (excepting VA in 1987 and NJ in 1988) are the median estimates resulting from the fishery simulation model, stratifying catch and effort observations by week, area and boat type. For the 1987 VA catch estimate, the monthly average catch per trip was multiplied by the monthly effort levels were provided by survey personnel based in VA. New Jersey state personnel conducted the survey within NJ in 1988 and provide the catch estimate shown. The limits within which 90% of the catch estimates fall are shown in Table 3. Since the estimates for 1987 VA and 1988 NJ were point estimates, no limits are shown for those cells. However, the point estimate values are incorporated in the "TOTAL" lower (LCL) and upper (UCL) confidence limits; for these cases the confidence range is greater than what is shown, but we cannot quantify this difference.

The yearly average weight of yellowfin measured during the LPS is shown in Table 4. These weights were multiplied by the median catch estimates to obtain yield estimates within the LPS survey area and time period (Table 5).

Median catch estimates were obtained from the MRFSS for areas and times not covered by LPS. These values, along with upper and lower confidence limits, are shown for both LPS and MRFSS in Table 6. The total catch levels, and the relative contributions from each survey area, are illustrated in Figure 1. For every year but 1994, there is a greater catch estimated in the MRFSS only survey area/time than in the LPS survey area/time.

The yearly average weight of yellowfin measured during the MRFSS is shown in Table 7. These values indicate that smaller fish, on average, are observed within the MRFSS only survey area. These smaller weights were multiplied by the MRFSS median catch estimates to obtain yield estimates from the MRFSS for areas and times not covered by LPS (Table 8). The results suggest that yield is more equally shared among the survey areas than catch (Figure 2).

The nominal catch per trip data from the LPS is shown in Figure 3. Data for NC are not available prior to 1992. Although resultant catch estimates depend on the corresponding effort levels, relatively high catch rates in 1987, 1991 and particularly 1994 match with relatively high catch estimates. This would suggest that, even if a correction to 1994 effort levels would tend to lower estimates, 1994 catch estimates would remain relatively high.

Literature Cited

- Brown, C.A. and H. Huang. 1994. Standardized catch rates of small bluefin tuna, *Thunnus thynnus*, in the Virginia - Rhode Island (U.S.) rod and reel fishery. Int. Comm. Conserv. Atl Tunas, Col Vol Sci. Pap. 44(2):SCRS/94/134.
- Turner, S. C., J. Cramer and C. A. Brown. 1992. Indices of abundance for large bluefin tuna, *Thunnus thynnus*, rod and reel/handline fishery off the northeast United States. Int. Comm. Conserv. Atl Tunas, Col Vol Sci. Pap. 39(2): 758-777.
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TABLE 1.

LPS TYPICAL TIME PERIODS FOR WHICH CATCH SAMPLES ARE OBTAINED		
AREA	START	END
NC	1992 - mid May 1993 - mid May	1992 - late June 1993 - mid July
VA	mid May to early June	late Sept. to late October
MD/DE	mid May to early June	late Sept. to late October
NJ	late May to early June	late Oct. to early November
NY	late May to early June	late Oct. to early November
CT/RI	early to mid June	early to mid October
MA	early to late June	early to late October

These dates represent the time periods for which trip interviews are typically obtained. Although sampling coverage may extend slightly earlier and/or later, estimated catch is assumed to be zero outside the window of observed trip activity.

TABLE 2.

LPS YELLOWFIN TUNA CATCH ESTIMATES (Numbers of fish)								
AREA	YEAR							
	1987	1988	1989	1990	1991	1992	1993	1994 ^c
NC						1635	10508	45684
VA	9916 ^a	8419	2373	873	11723	1425	2914	16241
MD/DE	15407	5317	2856	1368	6789	3515	5097	20272
NJ	14382	13027 ^b	11483	3188	21383	4547	7401	49617
NY	7044	2517	5748	4629	4311	6344	5163	29853
CT/RI	20564	1271	2964	2945	2213	1315	3913	24898
MA	843	395	272	121	129	285	282	5115
TOTAL	68233	31187	25896	13303	46771	19934	35851	192474

Blank values indicate data were unavailable or insufficient to derive estimates.

For the period 1987-1991, estimates were not stratified by boat type (charter/private).

Estimates were stratified by boat type for 1992-1994, with the exception of North Carolina in 1992.

^a No effort observations were available. The catch estimate was obtained by multiplying the average catch per trip by the number of trips each month estimated by VA personnel.

^b No effort observations were available. The catch estimate was obtained from a report prepared by NJ personnel.

^c Fleet size estimates for 1994 have not been finalized, therefore catch estimates are considered preliminary.

TABLE 3.

90% CONFIDENCE LIMITS FOR LPS YELLOWFIN TUNA CATCH ESTIMATES (in numbers)																
AREA	YEAR															
	1987		1988		1989		1990		1991		1992		1993		1994	
	LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL	LCL	UCL
NC											1484	1775	7327	17020	38158	58663
VA	----	----	7559	9364	2112	2687	686	1135	9503	15227	1259	1624	2428	3640	14672	18095
MD/DE	11354	23363	4127	7908	2308	3657	1024	2239	5019	9951	2374	7196	4464	6092	18598	22371
NJ	13379	15485	----	----	10376	12621	2938	3481	19928	22947	3558	6426	5990	9566	45243	55227
NY	6135	8336	1909	3491	4879	7032	3994	5385	3701	5117	5082	8419	4374	6244	26697	34589
CT/RI	17088	25240	1042	1572	2468	3799	2447	3621	1800	2695	877	3018	3303	4707	22487	28688
MA	631	1213	238	817	185	428	79	181	78	211	183	505	177	516	4275	6826
TOTAL	62665	77508	29380	34185	24054	27953	12255	14632	43274	51907	17283	23731	31637	42377	182268	208467

Blank values indicate data were unavailable or insufficient to derive estimates.

For the period 1987-1991, estimates were not stratified by boat type (charter/private).

Estimates were stratified by boat type for 1992-1993, with the exception of North Carolina in 1992.

^a The range of uncertainty around these estimates is unknown. Uncertainty around these estimates is not accounted for in the total estimates for these years. The values for the point estimates are incorporated in the "TOTAL" limits.

TABLE 4.

LPS AVERAGE WEIGHT FOR YELLOWFIN (in kilograms)								
AREA	YEAR							
	1987	1988	1989	1990	1991	1992	1993	1994
All areas	23.39	17.02	27.38	17.95	15.67	15.10	15.31	18.09

These values represent the yearly average weights of measured yellowfin as calculated from the length-weight relationship. These averages, when multiplied by the catch estimates, produce yield estimates.

TABLE 5.

LPS YELLOWFIN TUNA YIELD ESTIMATES (metric tonnes)								
AREA	YEAR							
	1987	1988	1989	1990	1991	1992	1993	1994 ^c
NC						24.7	160.9	826.4
VA	231.9 ^a	143.3	65.0	15.7	183.7	21.5	44.6	293.8
MD/DE	360.3	90.5	78.2	24.6	106.4	53.1	78.0	366.7
NJ	336.3	221.8 ^b	314.4	57.2	335.1	68.6	113.3	897.6
NY	164.7	42.8	157.4	83.1	67.6	95.8	79.1	540.0
CT/RI	480.9	21.6	81.2	52.9	34.7	19.9	59.9	450.4
MA	19.7	6.7	7.4	2.2	2.0	4.3	4.3	92.5
TOTAL	1595.7	530.9	709.1	238.8	733.0	300.9	548.9	3481.9

Blank values indicate data were unavailable or insufficient to derive estimates.

For the period 1987-1991, estimates were not stratified by boat type (charter/private).

Estimates were stratified by boat type for 1992-1993, with the exception of North Carolina in 1992.

^a No effort observations were available. The catch estimate was obtained by multiplying the average catch per trip by the number of trips each month estimated by VA personnel. This was multiplied by the yearly average weight to obtain estimated yield.

^b No effort observations were available. The catch estimate was obtained from a report prepared by NJ personnel and was multiplied by the yearly average weight to obtain estimated yield.

^c Fleet size estimates for 1994 have not been finalized, therefore yield estimates are considered preliminary.

TABLE 6. LPS AND MRFSS YELLOWFIN TUNA CATCH ESTIMATES (in numbers) WITH APPROXIMATE 90% CONFIDENCE LIMITS (assumes normal error distribution)									
AREA	YEAR								
	1987	1988	1989	1990	1991	1992	1993	1994	
ATLANTIC									
LPS	62665 68233	29380 31187	24054 25896	12255 13303	43274 46771	17283 19934	31637 35851	182268 192474	
MRFSS (outside LPS area)	77508 167079	34185 66949	27953 68730	14632 19111	51907 59151	23731 31299	42377 75637	208467 185363	141443 185363
TOTAL	129357 235312	79581 98136	73905 94626	25808 32414	89929 105922	42161 51233	96013 111488	325029 377837	325029 430645
GULF OF MEXICO									
MRFSS	227 734	2571 5316	441 1289		2668 4300	3656 6064	7502 10764	3110 6217	
GRAND TOTAL	2370	10926	3767		6929	10056	15445	12425	
MRFSS +	130084 236046	84374 103452	75106 95915	25808 32414	94080 110222	47646 57297	106261 122252	331017 384054	
LPS	342008	122530	116724	39030	126364	66948	138243	437091	

TABLE 7.

MRFSS AVERAGE WEIGHT FOR YELLOWFIN (in kilograms)								
AREA	YEAR							
	1987	1988	1989	1990	1991	1992	1993	1994
All areas	11.89	10.71	13.82	7.82	8.54	14.42	10.14	8.46

These values represent the yearly average weights of measured yellowfin. These averages, when multiplied by the catch estimates, produce yield estimates.

TABLE 8. LPS AND MRFSS YELLOWFIN TUNA YIELD ESTIMATES (in metric tonnes) WITH APPROXIMATE 90% CONFIDENCE LIMITS (assumes normal error distribution)								
AREA	YEAR							
	1987	1988	1989	1990	1991	1992	1993	1994
ATLANTIC								
LPS	1465.52	500.14	658.63	220.02	678.16	260.91	484.41	3297.23
	1595.73	530.90	709.07	238.84	732.96	300.93	548.93	3481.85
MRFSS (outside LPS area)	1812.64	581.93	765.39	262.70	813.45	358.25	648.85	3771.17
	3296.35	947.23	1224.41	221.22	651.29	521.90	806.74	2002.33
TOTAL	1973.61	712.62	934.83	149.51	504.29	398.90	645.93	1561.23
	1181.65	536.11	713.73	101.04	390.47	305.88	517.18	1217.31
TOTAL	2466.32	1032.08	1380.98	323.59	1089.48	580.10	1027.66	4582.24
	3569.34	1243.52	1643.90	388.35	1237.25	699.83	1194.86	5043.08
GULF OF MEXICO								
MRFSS	48.94	151.12	92.82		61.25	284.17	582.76	119.94
	21.63	61.17	32.56		37.45	139.94	230.58	59.54
GRAND TOTAL	9.56	24.76	14.40		22.89	68.92	91.23	29.56
GRAND TOTAL	2487.52	1082.11	1409.48	323.59	1125.62	674.44	1106.24	4639.30
	3590.97	1304.69	1676.46	388.35	1274.70	839.77	1425.44	5102.62
LPS	4694.42	1527.26	1943.43	453.10	1423.77	1005.10	1744.64	5565.94

FIGURE 1. Total U.S. Recreational Rod and Reel Catch Estimates

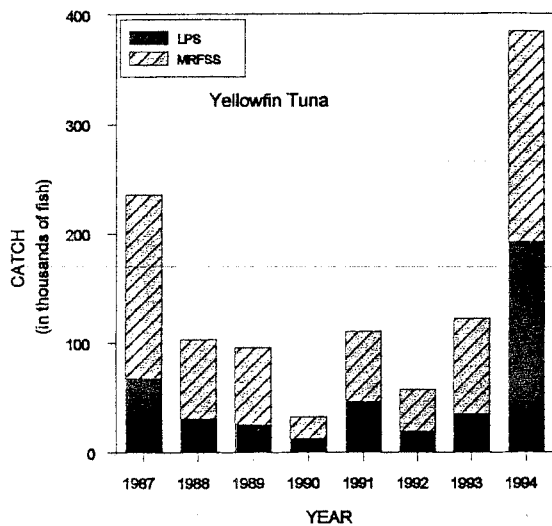


FIGURE 2. Total U.S. Recreational Rod and Reel Yield Estimates

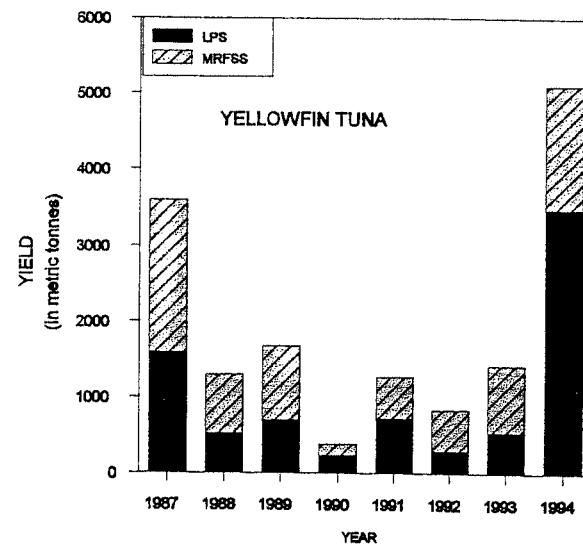


FIGURE 3. LPS NOMINAL CATCH PER TRIP

