

## FACTORS AFFECTING CATCH AND EFFORT IN THE U.S. PERMITTED FISHERY FOR ATLANTIC BLUEFIN TUNA

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### SUMMARY

Operational practices and marketing for the U.S. Atlantic bluefin tuna fishery are discussed. Performance in two permitted categories: Harpoon and General are examined for a block of professional captains from 1988 through 1992. Catch and effort data are compiled and discussed for use as an index of abundance.

### RESUME

Le présent document traite des caractéristiques de l'activité de la pêcherie de thon rouge de l'Atlantique par les Etats-Unis, et de sa commercialisation. L'activité de deux secteurs autorisés, Harpon et Général, est examinée à partir d'un groupe de patrons professionnels de 1988 à 1992. Les données de prise et d'effort sont étudiées quant à leur utilisation en tant qu'indice de l'abondance.

### RESUMEN

Se discuten las prácticas operativas y de marketing respecto a la pesquería estadounidense de atún rojo del Atlántico. Se examina la actuación en dos categorías permitidas, Arpón y General, de un grupo de capitanes profesionales, durante el período 1988 a finales de 1992. Se recopilan y discuten datos de captura y esfuerzo para su uso como índice de abundancia.

### INTRODUCTION

The U.S. Atlantic bluefin tuna fishery has two main components: a recreational component that (now) chiefly catches school size fish (<145 cm) and small mediums (145 to <178 cm) for sport and home consumption, and a commercial component that fishes for large mediums (178 to <196 cm) and giants (196 cm or greater) to sell. The components are further divided into categories of fishing. Each category is subject to a complex set of rules that govern most aspects of the operations including daily bag limits, seasonal quotas size limits, and gear restrictions.

#### Categories.

The commercial component is divided into four main categories: General, Harpoon, Incidental and Purse Seine. The General Category comprises several allowed types of hand gear including harpoon, hand lines and rod and reel. The Harpoon Category differs from the General Harpoon sub-category in that the former is restricted to one fish per day whereas the Harpoon Category knows no such limit. However, the Harpoon Category receives an annual quota about 10-percent that of the General Category, 53 mt in 1992 vs. 531 mt for the General Category. The Incidental Category was established to control incidental take during longline fishing operations for other species. The Purse Seine Category is a set-aside for five purse seine vessels that have been active in the fishery since the late 1960's.

#### Abundance Indices -

When the Commission in 1981 recommended management measure be implemented in the west Atlantic for bluefin, the recommendation was to reduce catches as near zero as possible. Allowance was made for some catch for scientific monitoring. The U.S. position at the time was that the status of the stock could best be monitored by CPUE data to be developed from the "recreational" rod and reel fisheries. The other fisheries - purse seine and harpoon were regarded as too dependent on market forces and weather to be of use. Thus began a series of catch and effort surveys of the rod and reel fishermen to develop

indices of abundance that could be used to tune the VPA (see for instance Turner *et al.* 1992.)

The procedure used involved dockside interviews of fishing vessels returning to the marina. This procedure has been criticized by some commercial fishermen and dealers for selecting boats that are likely to be returning without catching giant bluefin. Boats that are successful are claimed to return later after selling their fish, at a time the interviewers have gone home. Also, some commercial fishermen sell to buy boats and thus are unlikely to be interviewed. Finally, the interviews are more likely to contact poor fishermen than good ones thereby introducing greater uncertainty into the data.

What effect, if any, these factors may have on the abundance index for large bluefin cannot be answered easily from the available survey data. Nor is it possible from that data to separate fluctuations in CPUE that are caused by changes in availability or catchability, as opposed to changes in abundance.

The present study takes a somewhat different approach in an attempt to address some of the concerns expressed above. It uses a new data base developed from, daily catch information from a group of professional bluefin tuna harpoon and handline/rod and reel fishermen.

#### THE DATA

##### East Coast Tuna Association.

Seventeen members of the East Coast Tuna Association (ECTA) agreed to provide information from their personal logbooks and records to assist in this study. Sixteen data sets were usable. All fished for giant bluefin in the period from 1988 through 1992, all but two every year. Five of the fishermen fished in the Harpoon Category, Eleven in the General Category. Boat information and data sheets were designed and furnished by the ECTA (Appendix I). The fishermen completed the forms using personal records and logs supplemented by fuel receipts and fish ticket information. Some of the fishermen were able to provide hourly logbook records, all provided daily records summarized by week. Information was provided on area fished, type of gear: - Harpoon, Electric Harpoon, Airplane, General Harpoon, Rod and Reel (RR), Handline (HL), and/or Troll or Chum. In most instances length-weight and tag number information was provided for medium and giant bluefin. A total of 3043.5 days of fishing 1217 giants and 327 mediums are in the data base. Of these, 363 days and 342 giants belong to the Harpoon Category.

##### National Marine Fisheries Service.

The U.S. National Marine Fishery Service (NMFS) Northeast Regional Office provided data summaries of the catches and sizes of fish taken by the permit holders in the sample. These data were used to cross check the catches reported by the permit holders. In nearly all cases the two data sets agreed on the number of fish caught, tagged and sold. There were a number of discrepancies between lengths noted by the permittees and those in the

NMFS data base for the sample. Further, about 20-percent of the 1557 fish in the sample NMFS data base lacked length measures. For those fish that were measured, about half were measured from the insertion of the pectoral fin to the fork of the tail - Fin Length. The others were measured from the snout to the fork of the tail - Snout Length. When the fin lengths were converted to snout length using the constant factor of 1.35 and plotted, together with snout length fish, against the weight of the fish, they showed considerable variability beyond what would be expected from natural variation

#### ANALYSIS AND RESULTS

##### Captains and Boats, Areas, Gear.

Catches are not evenly distributed among the permit holders in the Harpoon and the General categories. According to NMFS (1993) in 1992 there were 10,879 vessels holding permits in the General Category and 112 in the Harpoon Category. Of these, 683 caught one or more fish in the general category and 30 caught one or more in the Harpoon category. The distribution of catches in the General Category (Fig. 1) indicates that few of the fishermen can be considered professional fishermen catching eight fish or more. Therefore the likelihood of the dockside interviews (Turner *et al* Ibid.) intercepting a successful fisherman is small, all other factors being equal. It is not surprising that fewer fish were caught with more effort in their survey than in the present sample (Table 1).

Table 1. Catch and Effort Data Base -General Category

Year	Turner <i>et al</i>		This Study	
	Trips (days)	No. Giants	Days (trips)	No. Giants
1988	261	36	267.5	58
1989	681	59	391	131
1990	888	45	437	121

The distribution of catches in the Harpoon Category is less skewed (Fig. 2). The most noticeable feature is that the number of boats taking fish has risen from 14 in 1990 to 30 in 1992. Also of note is that in each of the past three years a constant number of five or six boats have taken 17 or more fish per year even though the total number of successful boats has increase from 14 to 30.

Catch per day was about threefold greater in the Harpoon Category sample than in the General Category sample. This was not unexpected since there is (except at the end of the season in some years) a daily bag limit of one fish in the General Category. No such restriction applies to the Harpoon category. The average unadjusted CPUE for the eleven General Category fishermen (Giants only) in our sample was 0.27 (range 0.08-0.57). For the five Harpoon Category captains CPUE was 0.97 (range 0.79-1.12). The performance by different captains varied considerably and was considered a factor in the analyses that follow.

#### Area Fished.

All of the boats fished in about the same area of Cape Cod bay north into the Gulf of Maine to Jeffrey's Ledge, and offshore and south, east of Chatham, Massachusetts. Area did not appear to be a factor in fishing success for either sample category.

#### Boats.

The boats used by the sample captains ranged from 24-foot skiffs to 42-foot motor vessels, but most were in the 30- to 35-foot range, gasoline powered, single screw. There was no significant relation between average CPUE and boat length or engine type.

Airplanes were used by all of the Harpoon Category boats most of the time. They also were employed much of the time for harpoon fishing in the General Category. In addition, some of the General Category boats used airplane spotters when trolling. The use of aircraft resulted in significant increase in catch rates in all cases (Table 2).

Table 2. The Effect of Airplane Spotting on Average CPUE.

Category:	Average Catch of Giants per Day			
	Harpoon	Gen.(Combined)	Gen. RR/HL	Gen. Harpoon
Without	0.07	0.20	0.28	0.20
With	0.95	0.30	0.38	0.29

#### Regulations.

To explore what effect changed bag limits have on CPUE, catch rate for periods when the bag limit in the general Category was increase from one to two fish (8/19/88, 9/18/89 and 8/27/90) was compared with the overall catch rate. The result was not significant (0.20 vs. 0.23).

#### Age distribution of the catch.

The length data available from NMFS appears to have some problems and it was decided not to use it in attempting to assign ages to the catches in the various categories. Instead, reported weight was used. Weight is the basis for determining the selling price of the fish, and as such is less likely to be wrongly reported. These data are summarized in Table 3. for the sample fish and in Table 4. for the total U.S. Catch.

Table 3. Bluefin Average Round Weight (lb.) by Catch Category. Sample Catch

Year	Harpoon	GenHpn	Rod&Reel	Handline
1988	503	468	559	588
1989	458	500	623	580
1990	368	512	450	592
1991	485	542	537	493
1992	495	506	515	523

Table 4. Bluefin Average Round Weight (lb.) by Catch Category. NMFS Summary

Year	Harpoon	GenHpn	Rod&Reel	Handline
1988	462	463	565	611
1989	441	458	505	535
1990	397	474	537	547
1991	414	460	528	493
1992	418	463	468	488

From these summaries it appears the various types of gear are targeting different age groups of fish. In general the harpoon fish are smaller (younger) than hook and line fish. Some of the difference may be due to Harpoon Category fish being taken earlier in the year, but General Category harpoon fish that are taken later in the season also appear to be smaller than hook caught fish. Overall, the age composition of the sample catch appears similar to the larger NMFS sample.

#### Catch per Unit of Effort Calculations.

The preceding evaluation explored some of the limitations of the data base and attempted to identify factors that need to be explored further in standardizing the CPUE estimates. For this analysis the Harpoon Category was excluded since it operates in a different fashion and under different rules from the General Category. With less reason the General Harpoon category was also excluded from the analysis. This fishery is attractive in that it offers evidence of the presence of fish even when the "bite" may be slow. On the other hand it is clearly weather dependent, and requires the schools to be undisturbed. There also is some reason to separate handline and rod and reel fishing into separate categories for analysis, but gear type was not considered a significant factor in prior analyses (Turner *et al.* Ibid.), and doing so would reduce the sample size considerably.

The model developed for this analysis incorporates several effects. These are year, the three month July, August and September during which most of the fish are taken, the individual captains, and the use of an airplane. The model was run using days fished and giants caught, and days fished and giants and medium combined. The standardized results from the GLM are given in table 5. The diagnostics in Appendix II.

Table 5. Standardized CPUE for Commercial U.S. Hand Gear Fishermen.

Year	Standardized CPUE	
	Giants	Giants and Mediums
1988	0.511	0.571
1989	0.649	0.776
1990	0.430	0.529
1991	0.340	0.377
1992	0.542	0.549

#### CONCLUSIONS AND DISCUSSION

Attempting to use catch rates as a measure of abundance in these fisheries is complicated in that the data base does not include measures related to changes in availability and catchability. Turner *et al.* (Ibid.) included sea surface temperature in their models to attempt to account for some environmental effects. Other effects that could be measured, but have not, include weather conditions, which certainly will affect harpoon fishing - fog, low cloud, and wind/sea state over Beaufort 3. Major bad-weather periods such the passage of hurricane Bob, also may affect availability of fish even after passage of the bad weather. These factors could be examined using NOAA weather.

In the sample some of the General Category boats used harpoons almost exclusively. In most cases the boats carried harpoons and used them if the opportunity arose. Thus the mixed gear fishery is an attractive one for monitoring the presence of fish, and perhaps also a different group of fish, than the hook and line fisheries. However, such an analysis would be complicated by the one fish per day restriction, since a true measure of abundance cannot be got if good days are curtailed, and bad days are not.

More difficult to assess are factors that affect both availability and catchability such as over-crowding the fishing area, vessel traffic and competition among boats, and biological factors such as food availability. To further complicate interpretation of CPUE estimates, the range of this stock or species clearly extends far beyond the U.S. hand gear fishing ground, and at the same time of year. There is no reason to believe that a constant fraction of the stock is found in U.S. waters each year, yet that is the implication of using these CPUE series to tune the VPA. Using CPUE estimates from a restricted area of a restricted fishery to index abundance for a highly migratory species should be done with caution.

#### REFERENCES

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