

ANALYSIS OF CATCH AND EFFORT DATA FROM THE CANADIAN BLUEFIN TUNA ROD AND REEL FISHERY

P. C. F. Hurley, G. A. P. Black and T. D. Iles

Department of Fisheries and Oceans, St. Andrews, N. B., Canada

SUMMARY

The analysis of detailed fishing logs collected from the Canadian bluefin tuna rod and reel fishery over a five-year period produced three CPUE estimates. Two of these estimates, adjusted for increasing experience of the fishermen, yielded very high correlations when compared to west Atlantic and total Atlantic stock abundance estimates of the 11+ year-classes produced in recent VPA.

RESUME

Les trois estimations de la CPUE ont été dérivées de l'analyse de données détaillées provenant de carnets de pêche de la pêcherie canadienne de thon rouge à la canne et au moulinet sur une période de cinq années. Deux de ces estimations, ajustées pour tenir

compte d'une expérience accrue de la part des pêcheurs, ont montré un niveau élevé de corrélation par rapport aux estimations de l'abondance des stocks ouest-atlantique et Atlantique entier, pour les classes de 11 ans et plus, dérivées des analyses récentes de populations virtuelles.

RESUMEN

Las estimaciones de la CPUE vienen dadas por el análisis de los cuadernos de pesca de la pesquería canadiense de atún rojo, de caña y carrete, durante un periodo de cinco años.

Tres de estas estimaciones, bastante precisas debido a la creciente experiencia de los pescadores, dieron como resultado correlaciones muy altas al ser comparadas con las estimaciones de abundancia de stock del Atlántico occidental y del Atlántico total, relativas a las clases anuales 11 y más, mostrados en los recientes análisis de cohortes.

Regulations were introduced into the Canadian bluefin tuna rod and reel fishery in 1975 which fixed fishing effort at 1974 levels by fixing the number of participants and limiting the length of the season. The catch landed by this fishery (Fig. 1) rose to a peak in 1976 and has declined since that time, in spite of changes in regulations in 1979 increasing both number of participants and length of season. Hurley and Iles (1980) describe this fishery in more detail.

Detailed fishing logs were collected from fishermen during this five year period and three catch per unit effort estimates were obtained: mean number of fish landed per boat (Fig. 2), mean number of fish landed per day on fishing grounds (Fig. 3), and mean number of fish landed per hour on fishing grounds (Fig. 4). These three estimates are shown for two areas within the Gulf of St. Lawrence, Prince Edward Island waters and Chaleur Bay, and for the entire rod and reel fishery which also includes Newfoundland waters and both the Atlantic and Gulf of St. Lawrence coasts of Nova Scotia (Fig. 5). Catches within the last three areas were too sporadic and insignificant to be used separately. Number of fish landed per boat was considered to be too insensitive since it does not take into account the amount of time a boat spent on the fishing grounds during a season. However all three estimates show a decline in CPUE after 1976, in both Prince Edward Island waters and in the total rod and reel fishery, and each estimate follows the pattern of catches in each area well.

While the number of boats licensed in the fishery remained fixed as a result of regulations and the number of boats seriously involved declined (Fig. 6), there was a sharp increase in effort, in both total number of days (Fig. 7) and total number of hours (Fig. 8) spent on the fishing grounds in Prince Edward Island waters and in the total fishery after 1975. The mean effort per boat, both as number of days (Fig. 9) and number of hours (Fig. 10) spent on the fishing grounds, rose abruptly in 1976 as commercial interests became dominant in the fishery and remained relatively constant until 1979 when a substantial number of new, relatively inexperienced fishermen entered the fishery.

With a fixed group of fishermen with only limited replacement, it is obvious that a significant increase in experience would occur over a five year period. Experience leading to the successful landing of a fish can be broken into two distinct factors; that required to hook a fish and that required to boat a hooked fish. While it was not possible to estimate the first factor from the data available, the ratio of number of strikes to number of fish boated (Fig. 11) estimates the second factor. An experience index was produced from this ratio for each CPUE estimate, for each year and for each area and the CPUE estimates were adjusted accordingly. The resulting adjusted CPUE trends (Fig. 12, 13) show a continuous decline in both the total fishery and in the Prince Edward Island waters over this five year period. The 1978 points on the Chaleur Bay curves coincide with a year of unusually low bluefin abundance in that area. If these points are not included, a continuous decline in CPUE can be shown in this area also.

To examine the usefulness of these CPUE estimates as stock abundance indices, the adjusted CPUE estimates were compared to stock abundance estimates from a recent VPA (Parrack, 1980). Only the 11+ year-classes were used in this analysis since they are the year-classes taken in the fishery over this period. Simple linear regression correlations shown in Table 1 and 2 are high for both adjusted CPUE estimates from each of the areas considered and for both the west Atlantic and total Atlantic stock estimates. If the 1978 Chaleur Bay values are dropped from this analysis, the correlations in this area increase to compare with those of the other areas. Although no explanation is advanced at this time, it is also noteworthy that in the course of this analysis it was found that higher correlations (.987) were obtained using the 13+ year-class portion of both stock abundance estimates and that the degree of correlation decreased when a greater or lesser portion of the stock abundance estimates were used.

While the relationship between stock abundance and catch per unit effort is complex, the high correlations observed in this case are promising. Further analysis is proceeding to evaluate the use of these estimates as stock abundance indices.

LITERATURE CITED

- HURLEY, P. C. F. and T. D. ILES. 1980. A brief description of Canadian fisheries for Atlantic bluefin tuna. ICCAT Col. Vol. Sci. Pap. XI: 93-97.
- PARRACK, M. L. 1980. Trends of the abundance and age structure of Atlantic bluefin tuna. ICCAT Col. Vol. Sci. Pap. IX (2): 563-580.

TABLE 1. Adjusted CPUE vs. VPA estimated western Atlantic stock abundance of 11+ year-classes for 1975-79.

A - number of fish per 100 hours on fishing grounds vs. number of fish $\times 10^{-6}$

	<u>Slope</u>	<u>Intercept</u>	<u>r</u>
Total fishery	8.996	0.209	0.980
PEI	6.871	0.436	0.968
Chaleur Bay ^a	41.428	-2.345	0.935

B - number of fish per 10 days on fishing grounds vs. number of fish $\times 10^{-6}$.

	<u>Slope</u>	<u>Intercept</u>	<u>r</u>
Total fishery	7.064	0.121	0.969
PEI	5.866	0.253	0.954
Chaleur Bay ^a	23.132	-0.990	0.907

^aIf 1978 point dropped, r value increases to 0.987 and 0.977 for A and B respectively.

TABLE 2. Adjusted CPUE vs. VPA estimated total Atlantic stock abundance of 11+ year-classes for 1975-79.

A - number of fish per 100 hours on fishing grounds vs. number of fish $\times 10^{-6}$

	<u>Slope</u>	<u>Intercept</u>	<u>r</u>
Total fishery	3.3522	-0.1796	0.967
PEI	2.5692	0.1342	0.958
Chaleur Bay ^a	15.5005	-4.1695	0.927

B - number of fish per 10 days on fishing grounds vs. number of fish $\times 10^{-6}$.

	<u>Slope</u>	<u>Intercept</u>	<u>r</u>
Total fishery	2.6233	-0.1794	0.953
PEI	2.1797	0.0030	0.939
Chaleur Bay ^a	8.6294	-1.9951	0.896

^aif 1978 point dropped, r value increases to .970 and .955 for A and B respectively.

Figure 1. Number of fish landed in Canadian bluefin tuna rod-and-reel fishery from 1975-79.

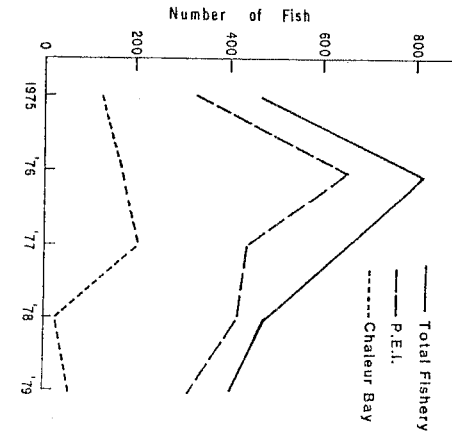


Figure 2. Mean number of fish landed per boat.

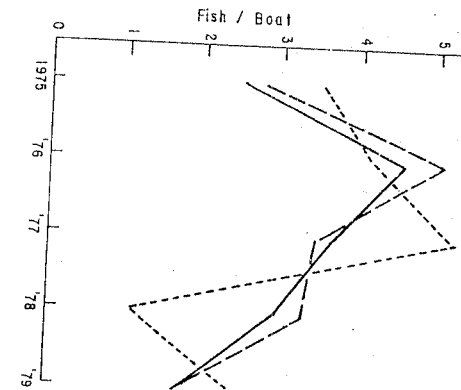


Figure 3. Mean number of fish landed per 10 days on fishing grounds.

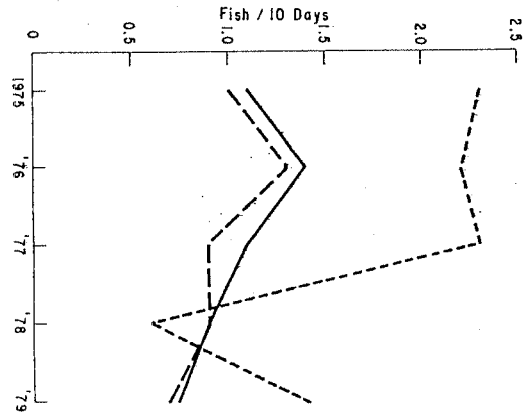


Figure 4. Mean number of fish landed per 100 hours on fishing grounds.

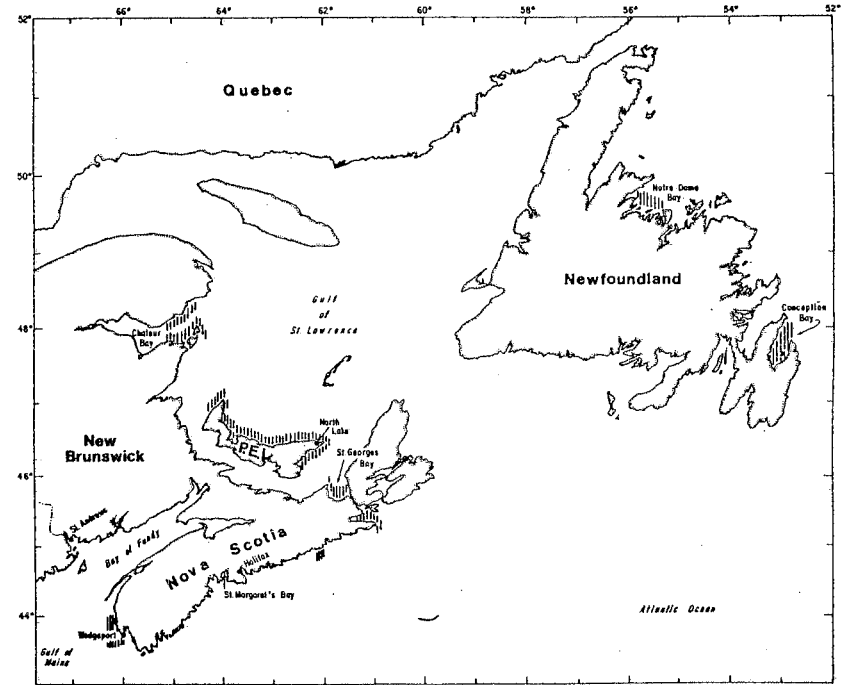
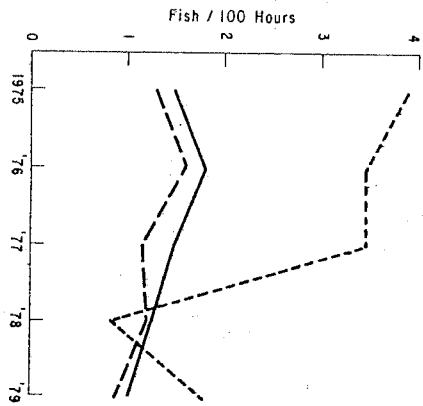


Figure 5. Fishing locations of the Canadian bluefin tuna rod-and-reel fishery.

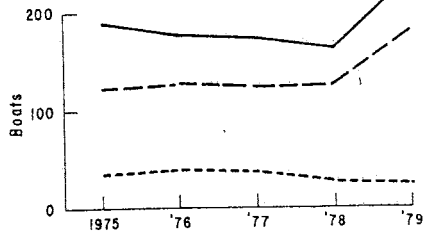


Figure 6. Number of boats in fishery.

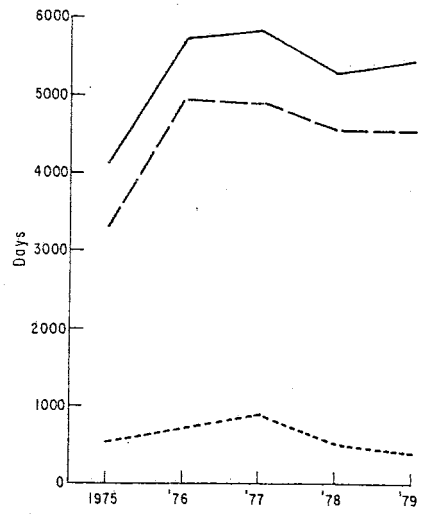


Figure 7. Total number of days on fishing grounds.

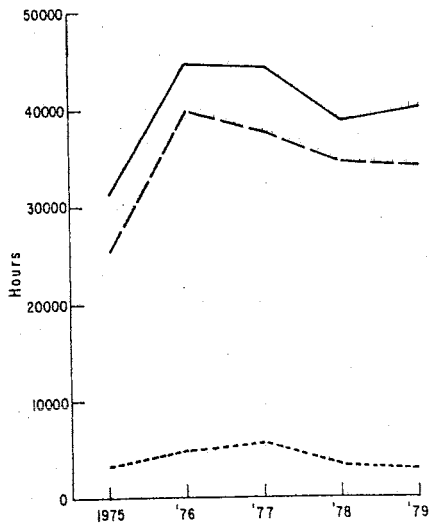


Figure 8. Total number of hours on fishing grounds.

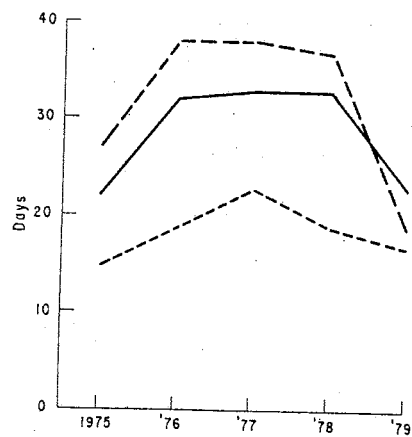


Figure 9. Mean number of days on fishing grounds per boat.

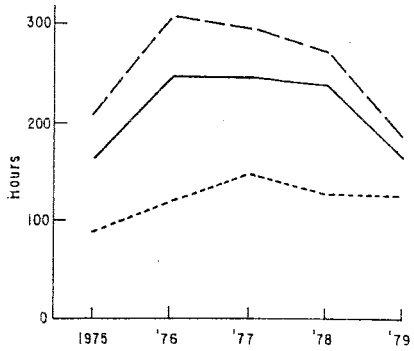


Figure 10. Mean number of hours on fishing grounds per boat.

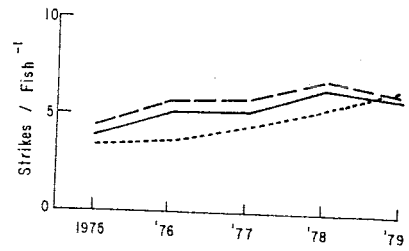


Figure 11. Experience estimate \sim (mean number of strikes per fish landed)⁻¹.

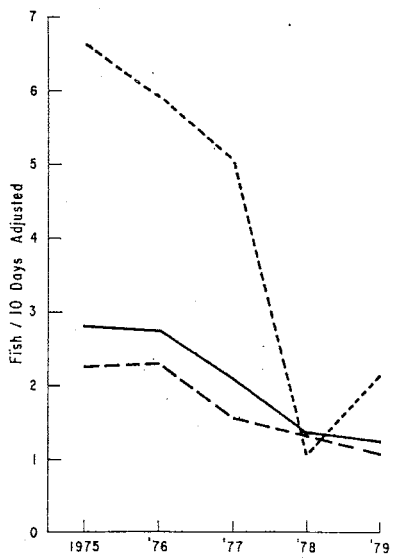


Figure 12. Mean number of fish landed per 10 days on fishing grounds adjusted for experience.

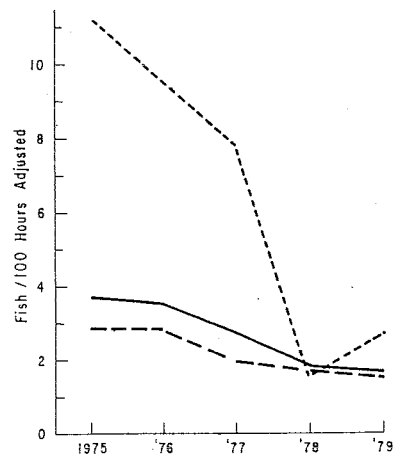


Figure 13. Mean number of fish landed per 100 hours on fishing grounds adjusted for experience.