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AN INITIAL ILLUSTRATIVE APPLICATION OF A CPUE*AREA APPROACH TO CHECKING ASSESSMENT CONSISTENCY FOR NORTH ATLANTIC BLUEFIN USING RECENT JAPANESE LONGLINE DATA

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SUMMARY

The assumption of constant catchability for Japanese longlining throughout the Atlantic and Mediterranean provides a basis to check the consistency of bluefin assessments for different regions. The methodology is explained, and an initial illustrative example provided which suggests that over recent years the relative abundances of bluefin in the east Atlantic+Mediterranean to the west Atlantic are in the ratio of about 3:1.

RÉSUMÉ

Le postulat d'une capturabilité constante pour la palangre japonaise dans tout l'Atlantique et la Méditerranée sert de base à la vérification de la cohérence des évaluations de thon rouge des différentes régions. La méthodologie est expliquée et un exemple illustratif initial est donné, lequel suggère que ces dernières années l'abondance relative du thon rouge dans l'Atlantique Est + la Méditerranée par rapport à l'Atlantique Ouest était d'un ratio de 3:1 environ.

RESUMEN

El supuesto de capturabilidad constante para la pesquería palangrera japonesa en todo el Atlántico y Mediterráneo proporciona una base para comprobar la coherencia de las evaluaciones de atún rojo para diferentes regiones. Se explica la metodología y se presenta un ejemplo ilustrativo inicial que sugiere que en los años recientes la ratio de las abundancias relativas de atún rojo en el Atlántico este + Mediterráneo con respecto al Atlántico oeste se sitúa en 3:1 aproximadamente.

KEYWORDS

Assessment, CPUE, longline

1. Introduction

Japanese longlining is a widely distributed and consistent method of fishing throughout the North Atlantic and Mediterranean. If the argument is accepted that the catchability q of this gear is reasonably taken to be independent of region in this overall ocean area, it is possible to make inferences concerning the areal distribution of total bluefin abundance.

This paper first outlines the associated methodology, and then provides an initial illustrative application.

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2. Methodology

CPUE is customarily assumed to be proportional to local density, *D*:

$$CPUE_\alpha = q\,D_\alpha \qquad \text{for area } \alpha$$

$$\Rightarrow CPUE_\alpha\ A_\alpha = q\ D_\alpha\ A_\alpha \qquad \text{where } A_\alpha \text{ is the open ocean area for } \alpha .$$

Adding over the constituent areas of a region:

$$\sum_\alpha CPUE_\alpha .\, A_\alpha = q \sum_\alpha D_\alpha\ A_\alpha = q\ B .$$

Thus the biomass in region $B = \frac{1}{q}\sum_\alpha CPUE_\alpha\ A_\alpha$.

Hence, for example, for the West Atlantic:

$$B^W = \frac{1}{q}\sum_{\alpha(W)} CPUE_\alpha^W\ A_\alpha^W$$

and for the East + Mediterranean:

$$B^E = \frac{1}{q}\sum_{\alpha(E)} CPUE_\alpha^E\ A_\alpha^E$$

These relationships could be used in two ways to inform the assessment process:

A) A consistency check: $\dfrac{B^W}{B^E} = \dfrac{\sum_{\alpha(W)} CPUE_\alpha^W\ A_\alpha^W}{\sum_{\alpha(E)} CPUE_\alpha^E\ A_\alpha^E}$; or

B) An assessment for the East + Mediterranean $B^E = B^W \dfrac{\sum_{\alpha(E)} CPUE_\alpha^E\ A_\alpha^E}{\sum_{\alpha(W)} CPUE_\alpha^W\ A_\alpha^W}$

where B^W could be taken from, say, a VPA assessment for the west for age-classes targeted by Japanese longliners, and (at the simplest level) CPUE values be taken as averages over last few years.

3. Initial application

For this initial illustrative application, all Japanese longline catch (by number) and effort data for the five years 1999-2002 and 2004 have been used, with the basic area units considered being (the open ocean proportions of) 5x5 degree squares. Catch and effort are each summed separately for each such square for these five years, and the ratio of these two sums is used as the (nominal) *CPUE* for that square. The sums exclude the months of June and July. The reason for this exclusion is twofold: two reduce “double-counting effects” of the fishery following mature fish to their spawning grounds, which leads to concentration of effort in different areas over these months, and also to reduce the impact on results of the absence of Japanese longline effort in the Gulf of Mexico, where substantial quantities of bluefin are expected to be present during June and July only. The resultant catch distribution is shown in bubble-plot form in **Figure 1**.

Results shown in **Table 1** refer to regions 1 (Gulf of Mexico) through to 6 (Mediterranean Sea) as defined in **Figure 2** (taken from SCRS/2002/012). Open ocean areas quoted are in units of “5x5 degree square at the equator” (i.e. units of 900 sq nm). The “Area with effort” entries in this Table sum areas for all squares fished at least once during the 5-year period considered, and the “Area without effort” entries are the remaining open ocean areas of each region. Squares without any effort are treated as having *CPUE*=0 for the purposes of the *CPUE*Area* summation.

Some comments about these regions and the *CPUE*=0 assumption are appropriate. The Area with effort in region 1 is in the Caribbean Sea well away from the bluefin spawning grounds, and reflects no bluefin catch. In regions 2, 3 and 4, it may be reasonable to assume that the Japanese longline effort covers virtually all the bluefin habitat, so that assuming *CPUE*=0 in squares without effort will not introduce appreciable bias. This is likely not be the case for regions 5 and 6, so that the implications of, say, similar densities of bluefin in squares without effort to squares with effort need to be considered. However, since a large portion of region 5 seems unlikely to contain bluefin, calculations have been repeated by limiting the part of the region considered to 30-50^{o}N as a sensitivity (this has little impact on the *CPUE*Area* summation, as is evident from results in **Table 1**).

Indications of recent relative bluefin abundance in different regions can be inferred from the proportions shown in the final two rows of the Table. For example, under the traditional division of a western stock in regions 1 and 2, with an east plus Mediterranean stock in regions 3-6, the proportions shown suggest a east/west abundance ratio of about 2.9. If the eastern abundance index is recomputed assuming equal densities of fish in areas without effort to those with effort in regions 5 (limited to 30-50^{o}N) and 6, this ratio would change to about 3.3.

4. Possible future refinements

To the extent that longline catches reflect different sizes in different regions, there may be inter-region comparability problems for the *CPUE* indices used above. Such biases might be reduced by limiting the catch considered in the *CPUE* evaluations to a restricted common size or age ranges. Computing results for a number of 2-3 month rather than one 10 month period might further reduce any possible double counting biases. Ultimately other *CPUE* standardization factors might also be taken into account in calculations.

Table 1. Analysis by region using 1999, 2000, 2001, 2002 and 2004 Japanese longline data with June and July excluded. "SCA" is an abbreviation for "Sum of CPUE multiplied by Area", with the associated proportions shown summing to 1 over Regions 1 to 6.

	Region						
	1	2	3	4	5	5' (30N-50N)	6
Area with effort	10.220	60.020	23.820	6.120	85.900	10.550	3.630
Area without effort	10.340	23.710	1.220	3.900	24.180	3.800	1.110
Area with effort / total area	0.497	0.717	0.951	0.611	0.780	0.735	0.766
Sum of CPUE*A*100	0.000	1.427	2.066	0.496	1.129	0.954	0.597
Proportion of SCA (30N-50N)	0.000	0.258	0.373	0.090		0.172	0.108
Proportion of SCA	0.000	0.250	0.362	0.087	0.198		0.104

	Region combinations		
	2, 3 & 4	5' & 6	3, 4, 5' & 6
Area with effort	89.960	14.180	44.120
Area without effort	28.830	4.910	10.030
Area with effort / total area	0.757	0.743	0.815
Sum of CPUE*A*100	3.989	1.551	4.112
Proportion of SCA (30N-50N)	0.720	0.280	0.742
Proportion of SCA	0.698		

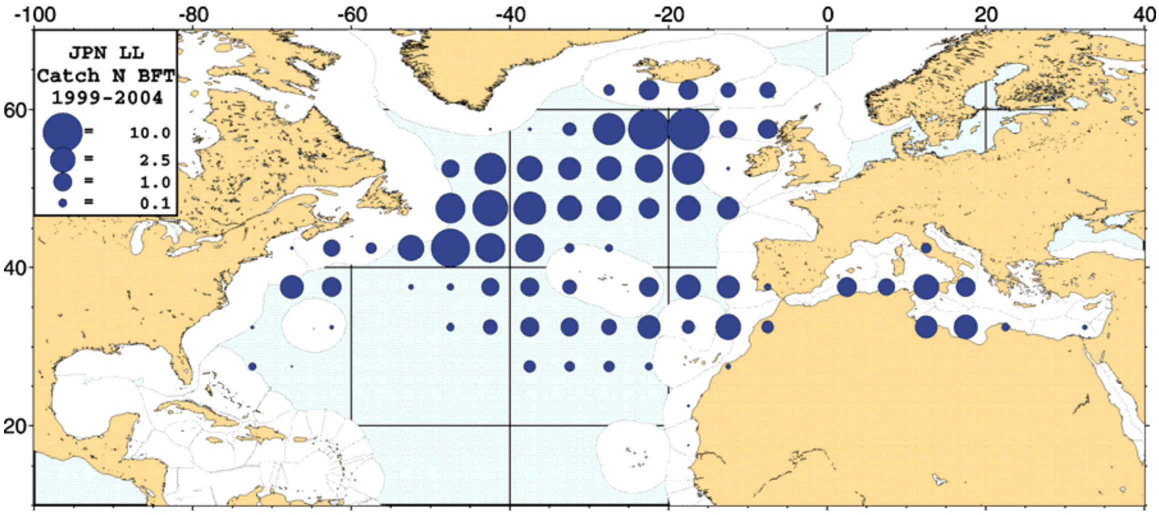

Figure 1. Distribution of Japanese longline catches over 1999-2002 and 2004, excluding the June-July period.

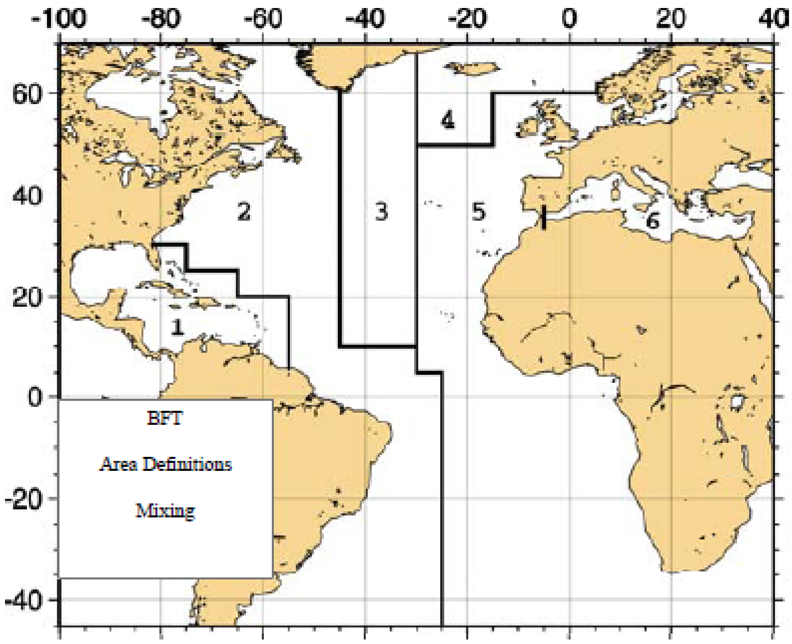

Figure 2. The Regions of the Atlantic and Mediterranean considered (from SCRS/2002/012).