A REVIEW OF THE RECENT INFORMATION ON SIZE AT AGE AND THE CALCULATION OF AGE FROM SIZE FOR ATLANTIC BLUEFIN TUNA

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SUMMARY

Information used by ICCAT scientists for growth curves for eastern and western Atlantic bluefin tuna are briefly reviewed and the systems for converting size to age for assessments are described.

RESUME

Le présent document passe brièvement en revue l'information utilisée par les scientifiques de l'ICCAT pour les courbes de croissance du thon rouge de l'Atlantique est et ouest, et fournit une description des méthodes de conversion de taille en âge pour les évaluations.

RESUMEN

Se examina brevemente la información empleada por los científicos de ICCAT en las curvas de crecimiento para el atún rojo del Atlántico este y oeste, y se describen los sistemas para convertir la talla en edad con el fin de llevar a cabo evaluaciones.

The purpose if this paper is to briefly summarize relevant information on Atlantic bluefin tuna biology and methods of conversion of catch at size to catch at age for use at the Consultation on the Technical Aspects of Methodologies which Account for Individual Growth Variability by Age. A more extensive review of the Atlantic bluefin biology as well as conversion of catch at size to catch at age was presented by Deriso and Bayliff (1991).

As with many rapidly growing species, distinct modes can be observed in size frequencies of smaller bluefin tuna as noted by multiple authors including Westman and Gilbert (1941) and Mather and Schuck (1960). Figure 1 (from Turner et al. 1991) illustrates this modality as shown in the west Atlantic bluefin catch at size.

For both east and west Atlantic bluefin, several investigations of hard parts for estimating age and growth have been conducted, however it has been difficult to establish that annuli observed in hard parts are formed once and only once a year. The correspondence of numbers of annuli and ages estimated from modal analysis have been interpreted by some as showing that annuli were valid indicators of age for smaller fish (Westman and Gilbert 1941 and Mather and Schuck 1960 among others). Studies of hard parts have been limited by the seasonality of the fisheries from which the samples were obtained, so that is has been difficult to establish the validity of annuli for older bluefin. None of the hard part studies have obtained samples throughout the year, so that it has been difficult to establish the validity of annuli through marginal increment or marginal tissue changes. Lee and Prince (1991) observed relatively close agreement between the number of annuli observed in hard parts and ages estimated from tagging for a small number of bluefin which were tagged at small sizes and recaptured after several years at liberty.

East Atlantic Growth and Maturity

The growth rate of east Atlantic bluefin tuna currently used by the SCRS is based on work by Cort (1991). Aging was based on sections of fin rays. Cort estimated that growth curve apparently using mean lengths at annulus formation for age 1-8 bluefin from the Bay of Biscay and mean lengths at capture by age from age 9-15 bluefin from Spanish traps.

Cort (1991) estimated the von Bertalanffy curve parameters to be L_∞=318.85 cm, k= 0.093 and t_0=-0.97; the curve is displayed in Figure 1.

All east Atlantic bluefin tuna are thought to mature by about 130 cm (4-5 years, Deriso and Bayliff, 1991) based on information from 28 fish from 75-139 cm collected by Rodriguez-Roda (1967) from Spanish traps. This contrasts sharply with the accepted size at maturity of west Atlantic bluefin of 200 cm (about 8 years).

West Atlantic Growth and Maturity

The growth rate of west Atlantic bluefin tuna currently used by the SCRS is based on work by Turner et al. (1991) which used mark-recapture data and information on modal length at ages 1-3 from fishery size compositions.

The von Bertalanffy parameters were estimated to be L_{∞}=380.1, k=0.079, and t_0=-0.731; the curve is displayed in Figure 1.

The SCRS assumes knife edge maturity at 200 cm (about age 8) for west Atlantic bluefin tuna based on sizes observed in the known spawning area.

Conversion from Size to Age

The SCRS currently uses age-slicing methods to convert catch at size to catch at age. Monthly size ranges at age are used for the east Atlantic-Mediterranean bluefin; the ranges are established using the growth curve. For the west Atlantic, size ranges specific to each year and month are used so that the size limits for ages 1-3 established from the growth equation can be changed when they appear to be inappropriate for separating modes. For smaller bluefin the size distributions are compared with the limits of size at age estimated from the growth curve and where clear differences are observed, limits of size at age estimated from size the distributions are used (Anon 1991). The SCRS has used the month of the catch for determining age.

Prior to the 1990 the SCRS used age-slicing with a growth equation which varied yearly (assumed different t_0's on an annual basis). The original growth equation used in those calculations was estimated by Parrack and Phares (1979). Nichols (1985) examined the size composition information of small west Atlantic bluefin tuna and noted that there appeared to be variation in t_0 among year classes. The SCRS attempted to incorporate those differences in its calculation of age from size (Deriso and Bayliff 1991). In 1990 the SCRS discontinued using the variable t_0's and began using the system of establishing size limits for younger ages from size composition data when the limits from the growth equation appeared to inappropriate as described above.

Literature Cited

Anonymous. 1991. Report for the Biennial period 1990-91. Part I (1990). ICCAT. 455 p.

Cort, J.L. 1991. Age and growth of the bluefin tuna (L.) of the northeast Atlantic. ICCAT. Col. Vol. Sci. Pap. 35(2): 213-230.

Deriso, R.B. and W.H. Bayliff. 1991. World meeting on stock assessment of bluefin tunas: strengths and weaknesses. IATTC. Special Report 7, 357 p.

Farber, M.I. and D.W. Lee. 1981. Ageing western Atlantic bluefin tuna, Thunnus thynnus, using tagging data, caudal vertebrae and otoliths. ICCAT. Col. Vol. Sci. Pap. 15(2): 288-301.

Lee, D.W. and E.D. Prince. 1991. Preliminary analysis of otoliths and vertebrae from nine tag-recaptured Atlantic bluefin tuna (Thunnus thynnus). ICCAT. Col. Vol. Sci. Pap. 35(2): 317-324.

Mather, F. J. III and H.A. Schuck. 1960. Growth of bluefin tuna in the western Atlantic Ocean. U.S. Fish Widl. Serv. Fish. Bull. 61(179): 39-52.

Parrack, M.L. and P.L. Phares. 1979. Aspects of the growth of Atlantic bluefin tuna determined from mark-recapture data. ICCAT. Col. Vol. Sci. Pap. 8(2): 391-420.

Rodriguez-Roda, J.1967. Fecundidad del atun, Thunnus thynnus (L.) del sur de Espana, en la compana almadrabera del ano 1966. Invest. Pesq. 31(1): 33-52.

Turner, S.C., V.R. Restrepo, and A.M. Eklund. 1991. A review of the growth of Atlantic bluefin tuna, Thunnus thynnus. ICCAT. Col Vol. Sci. Pap. 35(2): 271-293.

Westman, J.R. and P.W. Gilbert. 1941. Notes on age determination and growth of Atlantic bluefin tuna, Thunnus thynnus (Linneaus). Copeia 1941(2): 70-72.

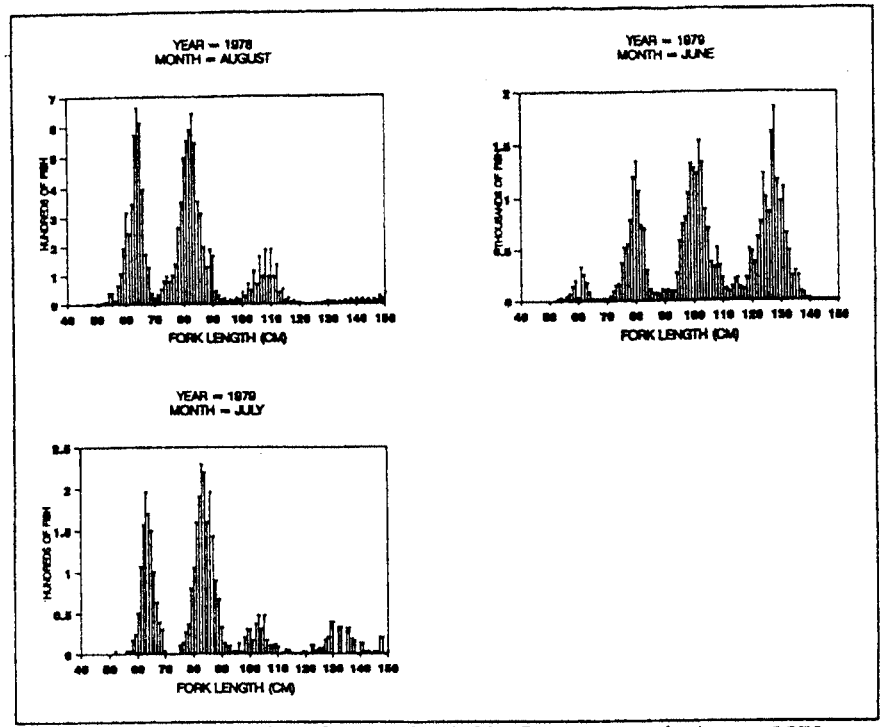

Figure 1. Size composition of west Atlantic bluefin < 150 cm in August 1978, June 1979 and July 1979 estimated by the SCRS; those months were selected as examples of the distinct modes apparent at smaller sizes.

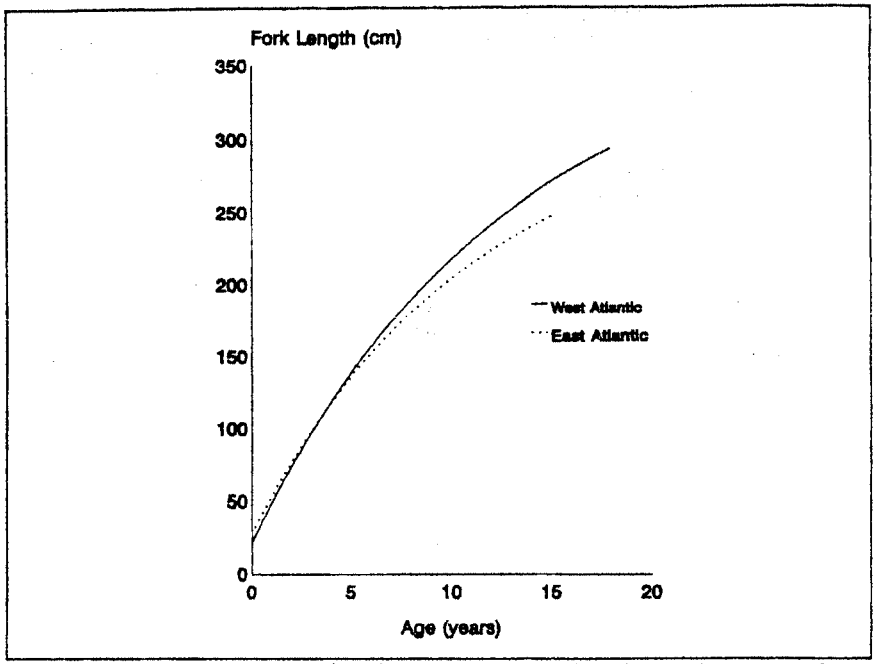

Figure 2. Estimated growth curves for east (Cort 1991) and west (Turner et al. 1991) Atlantic bluefin tuna .