RING COUNTS AND TIMING OF RING FORMATION IN FIN SPINES OF WHITE MARLIN (TETRAPTURUS ALBIDUS) FROM THE VENEZUELAN LONGLINE AND ARTISANAL FISHERIES

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SUMMARY

A total of 988 white marlin (422 males and 565 females) have been sampled from the commercial longline and artisanal gillnet fisheries in Venezuela as part of a larger study on the age and growth of Atlantic marlin. Sections from the third anal fin spine are used to age these animals. To date, spine sections from 575 of these individuals have been read and measured. The number of visible rings in the fin spine sections of samples processed and read to date ranged from zero to seven. The mode and the median were 2 for both fisheries. Note that these ring counts have not been corrected for possible ring loss due to vascularization of the fin spine. Relative marginal increment (RMI) analysis is being used to validate the ages. Preliminary results suggest a trend towards a single minimum in the fall, which would imply that the rings are formed once a year during this season. Samples available for April, May, and June, however, are still insufficient to reject the possibility that there is a second minimum in RMI during those months. More spines need to be obtained during these months to conclude that ring formation occurs only once a year.

RÉSUMÉ

988 makaires blancs (422 mâles et 565 femelles) ont été échantillonnés au total dans les pêcheries palangrières commerciales et les pêcheries artisanales au filet maillant au Venezuela, dans le cadre d’une étude plus vaste portant sur l’âge et la croissance du makaire de l’Atlantique. Des sections de la troisième épine de la nageoire anale sont utilisées pour déterminer l’âge de ces animaux. A ce jour, des sections des épines provenant de 575 de ces spécimens ont été lues et mesurées. Le nombre d’anneaux visibles dans les sections des épines de la nageoire des échantillons traités et lus actuellement allait de zéro à sept. Le mode et la médiane étaient de 2 pour les deux pêcheries. Il convient de noter que ces comptages d’anneaux n’ont pas été corrigés en vue d’une possible perte d’anneaux due à la vascularisation de l’épine de la nageoire. Une analyse de l’incrément marginal relatif (RMI) est actuellement menée aux fins de la validation des âges. Les résultats préliminaires suggèrent une tendance vers un minimum unique en automne, ce qui impliquerait que la formation des anneaux a lieu une fois par an au cours de cette saison. Les échantillons disponibles pour les mois d’avril, de mai et de juin sont toutefois encore insuffisants pour rejeter la possibilité qu’il existe un second minimum de RMI pendant ces mois. Il convient d’obtenir davantage d’épines durant ces mois pour conclure que la formation des anneaux n’a lieu qu’une fois par an.

RESUMEN

Se ha muestreado un total de 988 agujas blancas (422 machos y 565 hembras) en la pesquería comercial de palangre y en las pesquerías artesanales de redes de enmalle de Venezuela como parte de un estudio más amplio sobre la edad y el crecimiento de los marlines del Atlántico. Para determinar la edad de estos animales se han utilizado secciones de la tercera espina de la aleta anal. Hasta la fecha, se han leído y medido las secciones de espina de 575 de estos ejemplares. El número de anillos visibles en las secciones de la espina de la aleta de las muestras procesadas y leídas hasta la fecha oscilaba entre cero y siete. El modo y la mediana fueron 2 para ambas pesquerías. Cabe señalar que estos recuentos de anillos no han sido corregidos ante una posible pérdida de anillos debida a la vascularización de la espina de la aleta. Se está utilizando el análisis de incremento marginal relativo (RMI) para validar las

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1. Introduction

The white marlin (*Tetrapturus albidus*) is a sought-after gamefish and important foodfish in a number of small fisheries throughout the Atlantic. Recent stock assessments indicate the species is overfished, and that overfishing continues (ICCAT 2001, 2003). However, there is a high degree of uncertainty in these assessments, due in part to the lack of data on biological parameters such as growth and age structure of the catch. This limits the stock assessment to simple surplus production models instead of the more preferred age-structured approach (Anon, 2001; Anon, 2003).

To develop an age and growth model for white marlin, a sampling program has been initiated in several countries, including two fisheries in Venezuela. Sections from the third anal fin spine are used to age the fish. This paper presents some of our preliminary results on ring counts and the timing of ring formation in the fin spine sections for the Venezuelan fisheries.

2. Methods

Details of the sampling and sectioning protocol are described in Drew, et al. (2005). Ring counts are read from digital images of the magnified fin spines, and the program SigmaScan Pro 5 (SPSS, Inc) is used to measure the calibrated images. Measurements collected include the total cross sectional area and area of vascularization, as well as the radii of the spine section and individual rings (Figure 1).

To determine the periodicity of ring formation, relative marginal increment analysis is used (Campana, 2001). The marginal increment is calculated as the distance from the outer edge of the last ring formed to the edge of the spine section (Figure 1). The relative marginal increment is calculated by dividing the marginal increment by the width of the last complete increment formed. This ratio is at a minimum just after a new ring has been formed and at a maximum just before a new ring is formed.

3. Results

Spine sections from 575 individual white marlin from the Venezuelan fisheries have been read and measured. The mode and the median of ring counts were 2 for both fisheries, with a minimum of zero and a maximum of seven. It is important to note that these counts have not been corrected for potential ring loss due to vascularization. As fish (and their fin spines) grow larger, the size of the vascularized core of the spine increases. This means that there is the possibility that the earliest will be obscured by vascular tissue. The radius of the first visible ring increased with the radius of vascularization, and the mean radius of vascularization (3.05mm) was larger than the radius of smallest observed ring (1.40mm), suggesting that rings are in fact being lost (Figure 2).

To translate these ring counts into ages, the periodicity of ring formation must be determined. Although a chemical tag-recapture program is the preferred method of validating the annual nature of ring formation (Campana, 2001), the extremely low recapture rate for billfish makes this method infeasible. Instead, we are using relative marginal increment analysis, which has been used to validate the fin spine ageing technique for sailfish (Chiang et al., 2004) and swordfish (Ehrhardt, 1992). Due to the low number of processed samples from April, May, and June, the samples have been aggregated by season. When the average relative marginal increment (RMI) is plotted by season, there appears to be a trend towards a minimum in fall (Figure 3). This suggests that the rings are being formed once a year during a specific season. At this point, we cannot say that
the difference is statistically significant, because of the high variance and low sample size available at this time. Sample collection is ongoing, as is the processing and reading of the sections, so the power of these analyses will continue to increase. With a larger sample size, we will be able to complete the RMI analysis by month as well as season, allowing us to better understand the periodicity of ring formation.

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References

**Figure 1.** Spine measurements. $R_t =$ Total radius of spine. $R_{lr} =$ Radius of last ring. $R_{2lr} =$ Radius of second to last ring (in this case, since there are only two rings, it is also the radius of the first visible ring). $R_v =$ Radius of vascularization. $MI =$ Marginal increment ($R_t - R_{lr}$).

**Figure 2.** Radius of first visible ring vs. radius of vascularization. Increasing trend suggests earlier rings are being obscured by vascularized tissue.
**Figure 3.** Average relative marginal increments from the third anal fin spine by month for males (A) and females (B). Error bars are 95% confidence intervals. Numbers above the data points indicate sample size.