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RELATIONSHIP BETWEEN FORK AND INTESTINE LENGTH IN ATLANTIC BLUEFIN TUNA (*THUNNUS THYNNUS*)

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SUMMARY

Fish fork length data provide necessary information for catch statistics, fisheries biology and population studies. However, in bluefin tuna sampling, it is not always possible to collect fish measurements and researchers have to resort to biometric relationships. Through a linear function, we estimated bluefin tuna straight fork length (SFL) from intestine length and found a strong relationship between these variables (SFL =1.58 IntestineL -1.98, r^2= 0.96). This linear function can be used in future SFL estimations. Furthermore, the inverse of the slope of this equation represents the Nikolsky index (I_i), which provides information about feeding habits and classifies fishes as carnivore, omnivore or herbivore. We have obtained a Nikolsky index value of 0.64, which points to Atlantic bluefin tuna as a carnivorous fish. This observation is in agreement with previous studies.

RÉSUMÉ

Les données sur la longueur à la fourche des poissons fournissent des informations nécessaires aux statistiques de capture, à la biologie des pêcheries et aux études de population. Toutefois, dans l'échantillonnage du thon rouge, il n'est pas toujours possible de recueillir les mesures des poissons et les chercheurs doivent avoir recours aux relations biométriques. Par le biais d'une fonction linéaire, nous avons estimé la longueur fourche en projection horizontale (SFL) du thon rouge à partir de la longueur de l'intestin et avons découvert une forte relation entre ces variables (SFL =1,58 IntestinL -1,98 ; r2= 0,96). Cette fonction linéaire peut être utilisée dans de futures estimations de SFL. De surcroît, l'inverse de la pente de cette équation représente l'indice Nikolsky (Ii), qui fournit des informations sur les habitudes trophiques et classe les poissons dans les catégories carnivores, omnivores ou herbivores. Nous avons obtenu une valeur d'indice Nikolsky de 0,64, qui signale que le thon rouge de l'Atlantique serait un poisson carnivore. Cette observation est en accord avec les études antérieures.

RESUMEN

Los datos de longitud a horquilla facilitan información necesaria para las estadísticas de captura, biología de las pesquerías y estudios de población. Sin embargo, en el muestreo de atún rojo no siempre es posible recopilar mediciones de los ejemplares, y los investigadores tienen que recurrir a relaciones biométricas. Mediante una función lineal, se estimó la longitud a horquilla recta (SFL) a partir de la longitud del intestino y se halló una fuerte relación entre estas variables (SFL = 1,58, L de intestino -1,98, r2 = 0,96). Esta función lineal puede utilizarse en futuras estimaciones SFL. Además, la inversa de la inclinación de esta ecuación representa el índice Nikolsky (Ii), que proporciona información sobre hábitos alimentarios y clasifica los peces como carnívoros, omnívoros u herbívoros. Se obtuvo un valor de índice Nikolsky de 0,64, que indica que el atún rojo del Atlántico es un pez carnívoro. Esta observación coincide con estudios anteriores.

KEYWORDS

Atlantic bluefin tuna, biometric relationships, gut index

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1. Introduction

Fish fork length measurements are routinely taken from commercial fishery samples in order to obtain basic information on catch statistics, fisheries biology and population studies. This information is not always available because the high value of a species makes sampling impractical or because industrial fish processing prevent such measurements from being recorded. In these cases biometric relationships are used to estimate the size of fishes (Härkönen, 1986; Froese and Pauly, 1998). Atlantic bluefin tuna (*Thunnus thynnus*) size and weight relationships have been reported in several papers with a view to obtain the unknown value of one of these parameters from the other (Parrack et al., 1979; Rodriguez-Roda, 1983; Cort, 1990; Idrissi and Abid, 2011).

In trophic ecology studies based on stomach content analysis, Atlantic bluefin tuna viscera or guts are most often accompanied by no size data of the fish. Thus, with the purpose of providing accurate fork length estimates from intestine length data we assessed the suitability of using the gut index of Nikolsky (1963). This will allow us to obtain useful information of the size of Atlantic bluefin tuna sampled,). Nikolsky (1963) also used this index for providing general information about feeding behaviour, classifying fishes as carnivores, omnivores or herbivores.

2. Material and methods

Straight fork (SFL) and intestine lengths (IntestineL) were measured from 411 tuna captured in 2008-2010 in the Mediterranean Sea and eastern Atlantic Ocean areas. SFL was measured as the straight line from the end of the upper jaw (end of the snout) to the posterior of the shortest caudal ray (fork of the caudal fin). IntestineL was measured from the anal pore to the caeca.

Atlantic bluefin tuna lengths ranged between 21 and 263 cm. Three size classes were considered (small, medium and large). The small class (SFL between 21 and 38 cm) was caught by trolling off Cartagena (Murcia, SE Spain, "project SELFDOTT"). The medium class tuna (65-92 cm) were captured in the Cantabrian Sea by artisanal baitboats. The large class fish (108-263 cm) were captured by traps located in the Gibraltar Strait (southern Spain) and Larache (Morocco), by longliners fishing around the Balearic archipelago and Tyrrhenian Sea, and by purse seiners fishing around Balearic Islands area.

The gut index was defined by the equation:

$$I_i = IntestineL_i/SFL_i,$$

where, IntestineLi: intestine length (cm), SFLi: straight fork length (cm). This index can be used to estimate general feeding habits by classifying fishes as follows: carnivore ($I_i<1$), omnivore ($1< I_i<2$) and herbivore ($I_i>2$) (Nikolsky, 1963).

The relationship between fork and gut lengths was studied by a simple lineal regression using Statgraphics 5.1. We assumed a statistically significant relation when P-value was <0.01.

3. Results and discussion

Sizes of the tuna measured during the period 2008-2010 are shown in **Figure 1**. Three modes can be clearly distinguished corresponding to the three size classes.

There exists a significant relationship between the SFL and IntestineL. Therefore, IntestineL is a good linear predictor of SFL (SFL =1.58 IntestineL -1.98, r^2= 0.96) **(Figure 2)**, and this linear function can be used in future SFL estimations.

The inverse of the slope represents the gut index (Ii=0.64), which indicates that Atlantic bluefin tuna have a carnivorous feeding habit (Nikolsky, 1963), as was also reported previously from feeding studies based on stomach content analysis (Crane, 1936; Dragovich, 1970; Eggleston and Bochenek, 1990; Ortiz de Zárate and Cort, 1986; Chase 2002; Logan et al., 2011).

4. Acknowledgments

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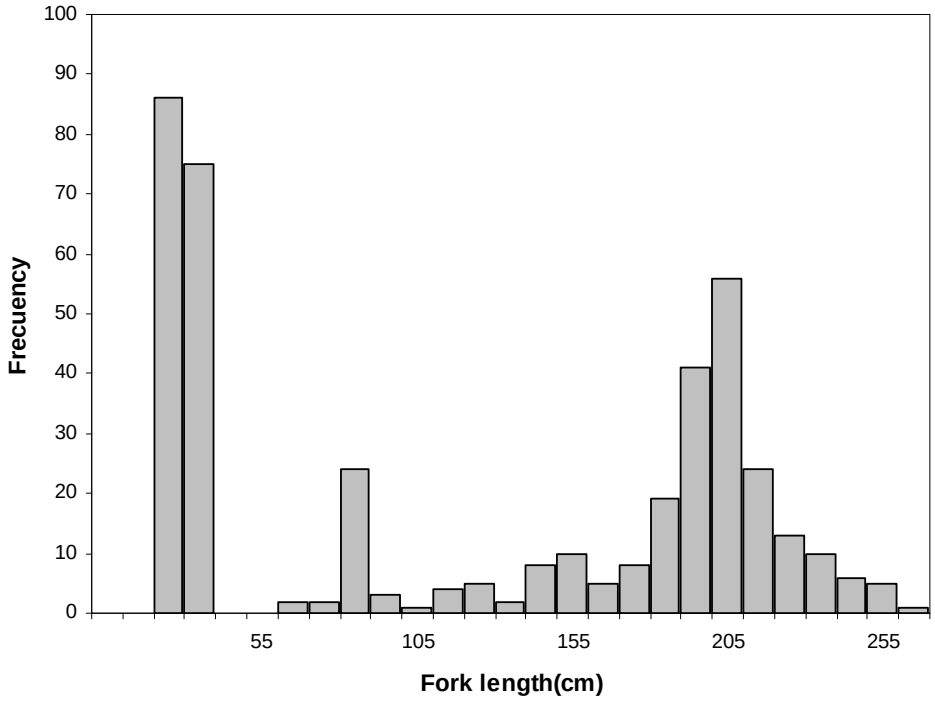

Figure 1. Straight fork length frequency.

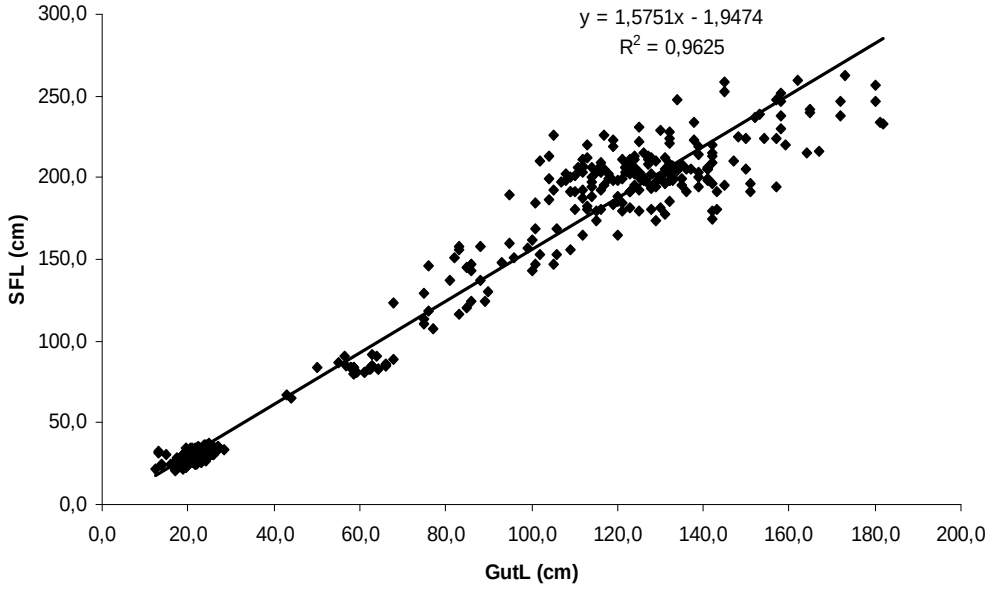

Figure 2. SFL-GutL relationship.