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AN EXAMINATION OF THE VERTEBRAL RINGS OF THE ATLANTIC SHARPNOSE SHARK, *Rhizoprionodon terraenovae*

Attempts at elasmobranch age determination have resulted in only limited success. At present there is no easy technique that can be used for ageing elasmobranchs in general. Use of the calcified rings which appear on the vertebra centra appears to be a promising technique. The annual nature of the rings has not been conclusively determined although there is mounting evidence which supports this hypothesis. Holden and Vince (1973) using tetracycline injections proved that at least for North Sea populations of the thornback ray, *Raja clavata* the rings are annual. Stevens (1975) compared blue shark, *Prionace glauca* vertebral ring age estimates with Aasen's (1966) Peterson distribution age estimates and found almost identical values for years one through four. These findings strongly suggest that the rings are annual.

Analysis of the vertebral rings of Atlantic sharpnose sharks, *Rhizoprionodon terraenovae*, are presented. Age estimations utilizing these rings are compared with age estimations made by Parsons (1981). A rapid method for ring elucidation is described.

MATERIALS AND METHODS

Specimens of *R. terraenovae* collected from the northern Gulf of Mexico between July 1979 and May 1980 and preserved in 10% formalin were utilized. Total length was measured for each specimen. A section of four to eight vertebrae was removed from the region of the vertebral column just anterior of the first dorsal fin origin. The vertebral section was cleaned of all muscle tissue and placed in 50% isopropyl alcohol for storage. A single intact vertebra was removed from the section with a scalpel. The centrum was cleaned of all tissue aside from the neural arch which was left intact for use as a reference point during measurements. Using forceps a single sheet of spongy connective tissue could be peeled from the concave face of the centrum. It was necessary to remove this soft tissue since its presence made ring elucidation more difficult.

To enhance ring clarity a simple technique was employed. After the centrum face had dried for about five minutes, the side of a number two lead pencil point held parallel to the inner surface of the concavity was used to accentuate the rings. This method detected any differences in microtopography and allowed the rings to be measured and counted. The radius of each ring, as well as the diameter and radius of each centrum, was measured to the nearest 0.1 mm. All measurements were made with calipers. Ring counts and measurements were made on the left and right lateral walls of the concavity. Samples of vertebrae used for this study are archived in the ichthyological collection of the University of South Alabama (USAIC).

RESULTS AND DISCUSSION

Vertebrae from fifteen male *R. terraenovae* (46.7 to 94.8 cm total length) were examined. Vertebrae centra diameters ranged from 5.1 to 12.1 mm and radii from 3.5 to 7.5 mm. Figure 1 shows that the relationship between centrum radius and shark total length is linear (r=0.94). Stevens (1975) found a similar linear relationship for the centra of the blue shark, *Prionace glauca*. This demonstrates positive allometric growth of the centra and is an important characteristic for a potential age indicator.

After accentuation, the vertebral rings could be easily counted and measured (Figure 2). Vertebral rings ranged from one to eight in number and averaged 3.2 to 6.6 mm in radius. Figure 3 shows the relationship between ring number and average ring radius. Assuming each ring requires approximately the same time interval for formation then the figure shows that growth of the centra is most rapid during the period between formation of rings one through three. Using Figures 1 and 3 average ring radii can be used to estimate the total length of the shark at ring formation (assuming ring formation occurs at the centrum edge). Average radii of rings one, two and three correspond to total lengths of 50, 58, and 68 cm respectively. The increase in vertebral ring radii and therefore the increase in shark total length slows after formation of ring three.

In this work a relationship between vertebral ring number and total length was observed (Figure 4). The plot shows an increase in the number of vertebral rings with increasing total length of the shark. This type of relationship has been demonstrated in a number of elasmobranch species (Daiber 1960; Taylor and Holden 1964; Stevens 1975).

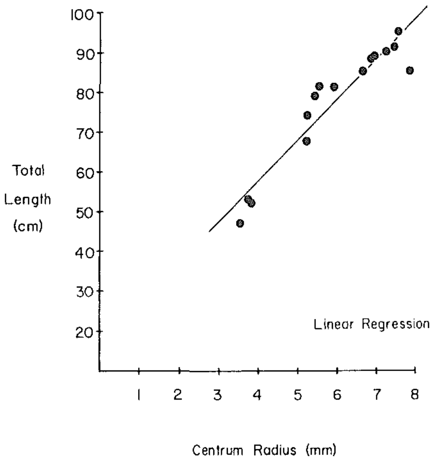

Figure 1. The relationship between centrum radius and shark total length for *Rhizoprionodon terraenovae* (N=15).

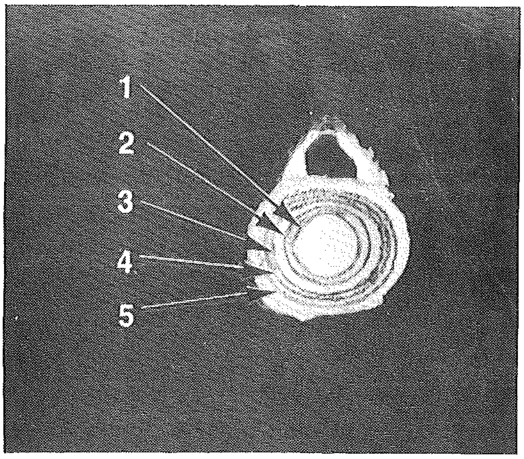

Figure 2. A photograph of an *R. terraenovae* vertebral centra showing the accentuated rings (2x magnification). This vertebra was taken from an 83.5 cm adult.

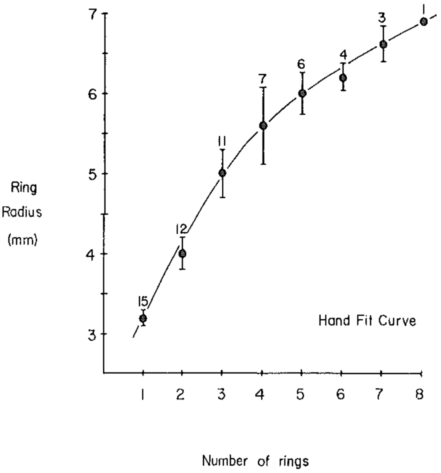

Figure 3. The relationship between the number of vertebral rings and vertebral ring radius. The plot shows the average ring radius (●), the 95% confidence interval (I), and the sample size.

Parsons (1981), using age classes estimated from *R. terraenovae* collection data, reported that fish born at ca. 32 cm total length leave Age Group 0 at ca. 65 cm and fish ca. 65 to 80 cm belong to Age Group 1. These values represent an annual growth increment of about 30 and 15 cm per year for Age Group 0 and 1 respectively. If the vertebral rings of

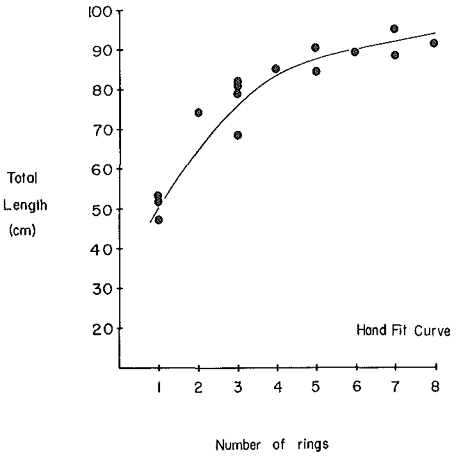

Figure 4. The relationship between the number of vertebral rings and total length for *Rhizoprionodon terraenovae* (N=15).

R. terraenovae are annual then the results of this study suggest that Age Group 0, 1, and 2 fish are about 50 cm or less, about 50 to 65 cm, and about 65 to 75 cm respectively (Figure 4). Stevens (1975) assumed that the rings on the vertebrae of the blue shark are annual and that the first ring represents a birth-mark. Since vertebrae from recently born *R. terraenovae* were not examined, it cannot be determined whether or not the first ring is present at birth. However, if we assume ring number one to be a birth-mark, then fish between ca. 32 cm (average total length at birth) and ca. 65 cm total length could be placed in Age Group 1. These estimates represent yearly growth increments of ca. 30 and 10 cm for Age Group 0 and 1 respectively, and correspond well with the estimates of Parsons (1981).

Using these growth increment estimates, percent increase per year can be calculated. From birth (32 cm) to the end of Age Group 0 (65 cm) there is a ca. 100% increase in length. This decreases to about 15% and 7% for Age Group 1 and 2 respectively. These findings indicate that the growth rate of juvenile *R. terraenovae* is very rapid but decreases sharply after year one. From birth to maturity (ca 85 cm) sharpnose sharks increase at about 66% of birth length per year. Stevens (1975) used vertebral rings and reported growth from birth (45 cm) to a length of 300 cm required 10 years for the blue shark, *Prionace glauca*. This represents an increase of 56.7% (of birth length) per year. Tanaka *et al.* (1978) report that the Eiraku shark, *Galeorhinus japonicus*, grows from 24 cm at birth to about 110 to 125 cm in 15 years, representing a yearly increase of 24 to 28% of birth length. The lemon shark, *Negaprion brevirostris* increases from birth (60 cm) to maturity (245 cm) in about 6.5 years (Gruber 1981). This represents a yearly increase of 47.4% of birth length.

The environmental factor(s) which result in changes in calcification and thus vertebral ring formation are unknown. For some species these rings may be due to seasonal temperature changes (Everhart *et al.* 1975). However, sharpnose sharks are not subject to extreme temperature variations as are fish of more northern climes, owing to its offshore migration during winter months (Parsons 1981). Stevens' (1975) data suggest that calcified rings of the blue shark are formed during the spring and may be related to an increase in the food supply or change in diet in more northerly waters. Based on this study, no conclusion can be made concerning the cause of variable rates of centra calcification in *R. terraenovae*.

The sharks utilized for this study had been preserved in formalin for one to two years. LaMarca (1966) reports that due to the presence of formic acid in most solutions of formalin, vertebra ring decalcification may occur making staining techniques ineffective for accentuating rings. However, Thorson and Lacy (1982) used vertebrae that had been stored in formalin for 3 to 9 years to examine age and growth in the bull shark, *Carcharhinus leucas,* and obtained good results with silver nitrate stains. Likewise, formalin fixed *R. terraenovae* vertebrae give good results with silver nitrate stains (Jim Colvocoresses, pers. comm.). It should be noted that only male specimens were available for this study and since male and female growth rates may differ the results may not be applicable to female *R. terraenovae.*

The findings of this study suggest that the vertebral rings of *R. terraenovae* are annual. Figure 4 shows that the largest sharks examined in this study possessed five to eight vertebral rings and are estimated to be four to seven years old. In the northern Gulf of Mexico, *R. terraenovae* average 90 and rarely exceed 100 cm total length (Parsons 1981). This suggests that male *R. terraenovae* infrequently exceed seven years of age.

LITERATURE CITED

Aasen, O., 1966. Blahaien, *Prionace glauca* (Linnaeus), 1958. Fisken og havet, No. 1, 1-15.

Daiber, F.C. 1960. A technique for age determination in the skate, *Raja eglanteria.* Copeia (3) 258-260.

Everhart, H.W., A. W. Eipper and W. D. Youngs 1975. Principles of fisheries science. Cornell University Press, Chapt. 5.

Gruber, S.H. 1981. Lemon sharks: supply-sided economists of the sea. Oceanus, 24(4), 56-64.

Holden, M.J. and M.R. Vince 1973. Age validation studies on the centra of *Raja clavata* using tetracycline. Journal du Counseil, 35 (1), 13-17.

La Marca, M.J. 1966. A simple technique for demonstrating calcified annuli in the vertebrae of large elasmobranchs. Copeia (2), 351-352.

Parsons, G.R. 1981. Growth and reproduction of the Atlantic sharpnose shark, *Rhizoprionodon terraenovae.* MS Thesis, Univ. of South Alabama. 71 p.

Stevens, J.D. 1975. Vertebral rings as a means of age determination in the blue shark. (*Prionace glauca* L.). J. Mar. Bio.; Ass. U. K. (1975) 55, 657-665.

Tanaka, S., C.T. Chen and K. Mizue 1978. Studies on sharks-XVI. Age and growth of Eiraku shark, *Galeorhinus japonicus* (Muller et Henle). Bull. Faculty Fish., Nagasaki Univ. 45: 19-28.

Taylor, A.J. and M.J. Holden 1964. The preparation and use of vertebrae for age determination in rays. International Council for the Exploration of the Sea, Near Northern Seas Committee. C.M. Papers and Reports, No. 145, 1-5.

Thorson, T.B. and E.J. Lacy Jr. 1982. Age, growth rate and longevity of *Carcharhinus leucas* estimated from tagging and vertebral rings. Copeia, 1:110-116.

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