

## Oldest estimated age for *Sphyrna mokarran* (Carcharhiniformes: Sphyrnidae) in the Mexican Pacific

## Máxima edad estimada en *Sphyrna mokarran* (Carcharhiniformes: Sphyrnidae) en el Pacífico mexicano

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### ABSTRACT

The estimated age (around 45 years) from vertebral growth band counts for the largest *Sphyrna mokarran* caught in the Gulf of California and Central Mexican Pacific in the last decades, locates it as the oldest elasmobranch reported to date in Mexican Pacific waters. The specimen studied was a mature female of approximately 550 kg of total weight and 424 cm of total length, caught by artisanal fishermen using longlines south of the archipelago of Islas Marías on November 11<sup>th</sup> 2010. The distance between growth bands showed fast growth during the first 10 years. Growth bands after the age of 38 were only visible in the *corpus calcareum*, though difficult to separate and count. The age estimated in the present study was similar to the maximum age reported for the species in the Atlantic Ocean and Gulf of Mexico, confirming the species as long lived.

Key words: Great hammerhead shark, growth bands, maximum age.

### RESUMEN

La edad estimada (alrededor de 45 años) a partir del conteo de las bandas de crecimiento vertebrales del ejemplar de *Sphyrna mokarran* más grande capturado en el Golfo de California y Pacífico Central Mexicano en las últimas décadas, lo sitúan como el elasmobranchio de mayor edad reportado en aguas del Pacífico mexicano. El organismo estudiado fue una hembra madura de aproximadamente 550 kg de peso total y 424 cm de longitud to-

tal, capturada por pescadores artesanales con palangre, al sur del archipiélago de las Islas Marías el 11 de noviembre de 2010. La distancia entre las bandas de crecimiento mostró un rápido crecimiento durante los primeros 10 años de vida. Después de los 38 años de edad las bandas fueron sólo visibles en el *corpus calcáreo*, siendo difíciles de separar y contar. La edad estimada en el presente estudio fue similar a la edad máxima reportada para la especie en el Océano Atlántico y el Golfo de México, confirmando a la especie como longeva.

Palabras clave: Tiburón martillo gigante, bandas de crecimiento, edad máxima.

The great hammerhead shark, *Sphyrna mokarran* (Rüppell, 1837), is a coastal and semi-oceanic tropical species. It reaches up to 610 cm of total length (TL), though the common maximum size is around 360 cm of TL (Compagno, 1984) and the maximum reported length in Mexican waters (for a specimen caught near Acapulco, Guerrero) is 483 cm of TL (Applegate *et al.*, 1979). The aim of the present note is to report the largest *S. mokarran* caught by the artisanal shark fishery in the Gulf of California and Central Mexican Pacific, at least during the last two decades (Perez-Jiménez *et al.*, 2005). The maximum age estimation for the species in the Mexican Pacific, based on vertebral growth band counts, is reported for the first time as well. Bomb radiocarbon and marginal increment analysis indicated that growth bands are formed annu-

ally in the vertebrae of this species (Passerotti *et al.*, 2009; Piercy *et al.*, 2010).

The specimen studied was a mature female of approximately 550 kg of total weight and 424 cm of TL. TL was measured with a fiberglass tape to the nearest cm from the tip of the snout to the end of the tail by extending over the body axis (Compagno, 2001). The shark was caught on November 11<sup>th</sup> 2010, by artisanal shark fishermen from La Cruz de Huanacastle, Nayarit, by using long-lines south of the archipelago of Islas Marias located to the west of Nayarit coast, at the outer mouth of the entrance zone of the Gulf of California (Lavín & Marinone, 2003).

Fork length (FL), estimated with a conversion equation reported for the species from the north-western Atlantic Ocean and Gulf of Mexico ( $TL = 1.2533(FL) + 3.472$ ,  $n = 24$   $r^2 = 0.98$ ) (Piercy *et al.*, 2010), was 334 cm.

A sample of vertebrae from the region above the branchial chamber was obtained. After removing the connective tissues with a scalpel, forceps and a 5% sodium hypochlorite solution, vertebrae were washed with tap water and air dried. Sagittal sections of the centra closest to its focus (approximately 400  $\mu$  thick) were obtained with an Isomet (Buehler) low speed saw and examined with transmitted light in a compound microscope (Olympus SZ60), adapted to a video camera (Hitachi KP-D50) and a personal computer with the Image Pro Plus (v. 6.1) program. The maximum ratio of the vertebrae, from the focus to the edge of the vertebrae over the *corpus calcareum*, was measured with a digital caliper to the nearest 0.01 mm. Pairs of growth bands (one opaque and one translucent) were counted. The translucent band closest to the focus was assumed as the birth mark (Goldman, 2005). The estimated FL was compared to that obtained with the von Bertalanffy growth equation previously reported for females ( $FL = 307.8(1 - \exp(-0.11(t - 2.86)))$ ) (Piercy *et al.*, 2010), where  $t$  is the estimated age in years.

Although the size of the captured specimen was lower than the maximum reported size in Mexican waters (Applegate *et al.*, 1979), its presence was interesting, considering the scarcity of large individuals. The species had been recorded during several decades along the Mexican Pacific coast (including the western coast of the Baja California Peninsula and the Gulf of California) (Espinosa-Pérez *et al.*, 2004), but it is a rare species caught by the Mexican Pacific shark fisheries. The IUCN had catalogued it as endangered due to the concern about its low productivity and apparent population declines (Camhi *et al.*, 2009). Sharks of such size are particularly rare in artisanal fisheries, as a consequence of selectivity of the fishing gears used.

The vertebrae analyzed (maximum ratio = 25.77 mm) presented clear growth bands (Fig. 1). The estimated age was over 40 years (probably 45). Growth bands after the age of 38 were not visible in the *intermedialia* but they were in the *corpus calcareum*,

though difficult to separate and count. Consistent with previous studies (Piercy *et al.*, 2010), the distance between growth bands showed fast growth during the first 10 years, after which they became finer and tighter, as it happens in most shark species (Goldman, 2005).

*Sphyrna mokarran* has been categorized as a slow growing and long lived species, with one of the oldest age estimates for elasmobranchs and the oldest for temperate or tropical environments (Piercy *et al.*, 2010). The age estimated in the present study was only one year over the maximum age estimated for the species in the Atlantic Ocean and Gulf of Mexico (44 years for a 315 cm FL female), though the estimated FL for the specimen reported here was 19 cm larger. Such differences could be related to the great variability in size-at-age reported previously (Piercy *et al.*, 2010) and error associated to age estimation due to the difficulty to separate growth bands close to the edge in large animals. FL obtained with the von Bertalanffy equation (305 cm) with the estimated age in the present study was also lower than the converted FL from measured TL, but close to the asymptotic length reported previously for the species (307.8 cm) (Piercy *et al.*, 2010). Despite possible errors counting growth bands in the edge of the vertebrae, the studied organism here is the oldest elasmobranch reported to date in Mexican Pacific waters and one of the oldest *S. mokarran* aged around the world.

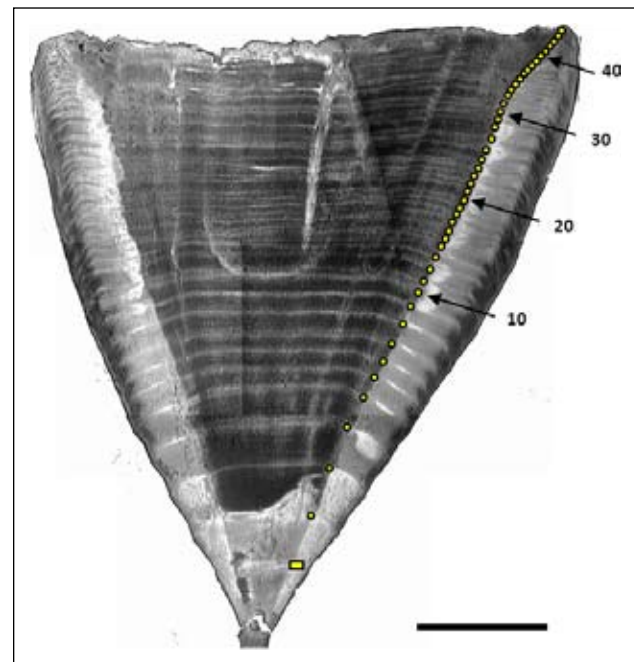


Figure 1. Sagittal section of a vertebra of *Sphyrna mokarran* (female of 424 cm of total length), caught off Nayarit in the Mexican Pacific (the dots represent annual translucent growth bands and the square the birthmark). Scale bar = 5 mm.

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