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***SHORT COMMUNICATION***

# PRELIMINARY AGE ESTIMATES FOR FEMALE SOUTHERN STINGRAYS (*HYPANUS AMERICANUS*) FROM SOUTHWESTERN FLORIDA, USA

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KEY WORDS: Dasyatidae, age and growth, life history, Charlotte Harbor, Gulf of Mexico

## INTRODUCTION

The Southern Stingray, *Hypanus americanus* (previously *Dasyatis americana*), is a common whiptail stingray of western Atlantic coastal waters, including the Caribbean Sea and the Gulf of Mexico (Robins and Ray 1986, Last et al. 2016). Although this stingray is important to ecotourism in the Caribbean Sea (Corcoran 2006) and is routinely captured as bycatch within southern trawl fisheries (Graham et al. 2009), it is currently not under direct threat of overexploitation. While biological and behavioral information has been reported for this species based on studies of both captive (Henningsen and Leaf 2010) and wild individuals (Funicelli 1975, Chapman et al. 2003, Corcoran 2006, Semeniuk et al. 2007), significant gaps in life history remain. The species is considered data deficient by the International Union for Conservation of Nature (IUCN) (Grubbs et al. 2016).

Age information forms the basis for calculations of growth and mortality rates, as well as productivity, making it one of the most important variables for estimating a population's status, including assessments of the risks associated with exploitation (Cailliet and Goldman 2004). Henningsen and Leaf (2010) provided initial age data on captive southern stingrays; however, no complementary work has been conducted on wild populations. Since growth in captivity may not accurately reflect growth in the wild (Mohan 1996), the goal of the present study was to provide preliminary age—at—width estimates of wild caught specimens using counts of growth bands from vertebral centra.

## MATERIALS AND METHODS

Southern Stingrays were opportunistically collected from angler fishing tournaments and charter boat anglers from 2004 to 2012 in Charlotte Harbor, Florida. One male was collected, and was omitted from the study due to potential differences in age and growth information between sexes. Upon capture, disc width (DW; mm) was measured as a straight line distance between the apices of the pectoral fins, and a section of the vertebral column was removed directly posterior to the pectoral girdle and stored frozen. Following the protocols of Sulikowski et al. (2003), the samples were thawed, muscle was removed, and vertebrae were stored in 70% ethanol. Individual centra were then sectioned along the sagittal plane using a Raytech Gem saw with 2 sintered diamond blades separated by a 0.6 mm spacer to produce a bowtie shaped cross section. The cross sections were then mounted on microscope slides using clear resin (Cytoseal 60; Fisher Scientific, Pittsburgh, PA). Once affixed to the slides, all cross sections were then viewed and photographed with a Leica EZ4HD dissecting microscope at 8 to 12.5x magnification (Figure 1). Two non—consecutive growth band counts were made by 2 independent readers for each specimen without prior knowledge of DW or previous count (Sulikowski et

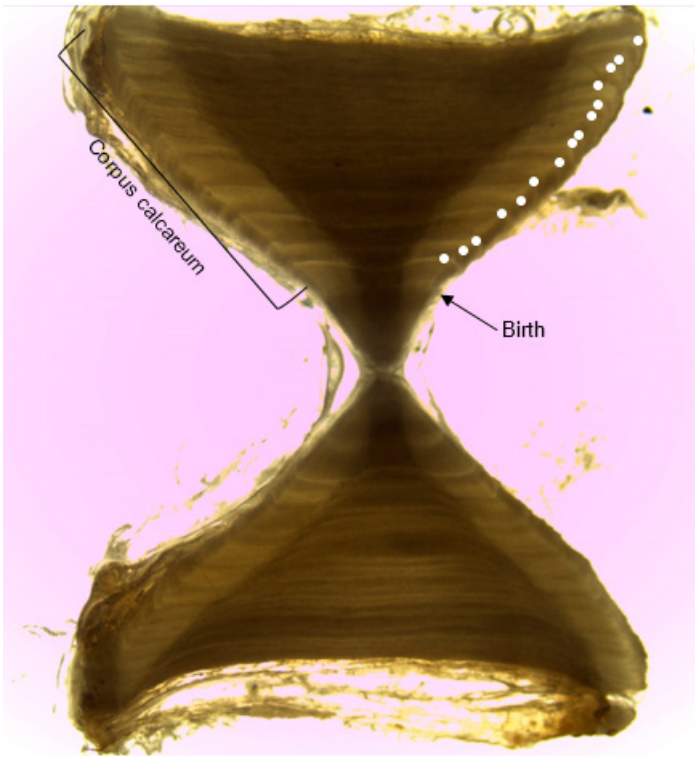


***FIGURE 1.*** *Cross-section of a vertebral centrum from a 1107 mm disc width female Southern Stingray (*Hypanus americanus*) estimated to be 15 years old. Structural parts of the vertebra are labeled and growth bands (purported annuli) are indicated by white circles.*

al. 2003). The birth band was marked by an angle change in the corpus calcareum (Cailliet and Goldman 2004); it represents age 0 and was therefore omitted from the total age of the individual. Although annual ring formation was not validated herein, it is understood that a growth band is defined as one opaque band paired with one translucent band (Cailliet and Goldman 2004). Precision and bias were assessed with the index of average percent error (IAPE) (Beamish and Fournier 1981), while age determination bias between readers was assessed using a bias plot (Campana 2001).

## Results

A total of 18 female Southern Stingray specimens ranging from 412 to 1127 mm DW were collected. All vertebrae were readable and growth bands were easily identified, with ages ranging from 0 to 17 years (Table 1). The age estimates resulted in an IAPE of 12.5%, suggesting that this method was a precise approach to determining age. Moreover, the age—bias plot suggests no significant bias existed between readers (Figure 2). A simple linear regression indicated a linear correlation between age estimates and disc width ($r^2$ = 0.8813, df = 16; $p < 0.001$).

***TABLE 1.*** *Age estimates, sample sizes, and disc widths for female Southern Stingray (Hypanus americanus) specimens captured in Charlotte Harbor, FL from 2004 to 2012.*

| Age estimate | Sample Size | Disc width (mm ± SE) |
|---|---|---|
| 0 | 1 | 412 |
| 1 | 1 | 427 |
| 6 | 1 | 760 |
| 7 | 1 | 781 |
| 12 | 3 | 1005 ± 21.22 |
| 13 | 5 | 910 ± 16.91 |
| 14 | 2 | 922 ± 5.37 |
| 15 | 1 | 1107 |
| 16 | 1 | 1127 |
| 17 | 2 | 1068 ± 1.06 |

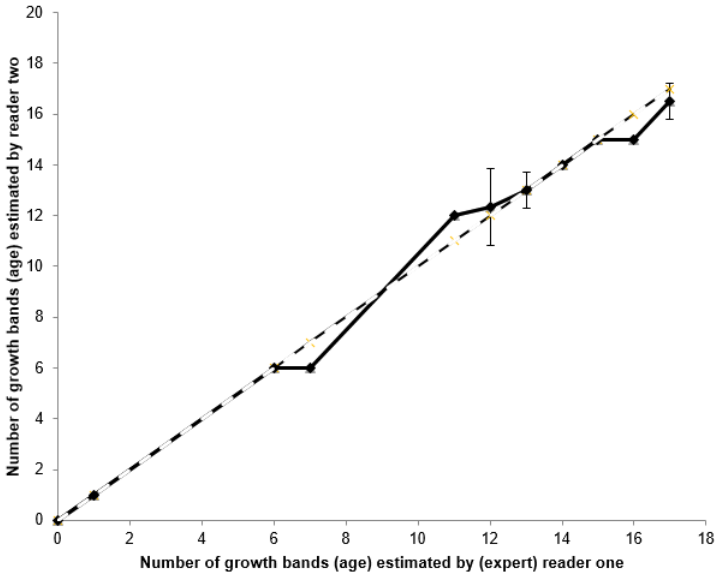


***FIGURE 2.*** *Age-bias plot for pair-wise comparison of 18 female Southern Stingray (Hypanus americanus) vertebral growth band counts by 2 independent readers. Each error bar represents the 95% confidence interval for the mean age assigned by reader 2 for all rays assigned an age by (expert) reader 1. The diagonal line represents the one-to-one equivalence line.*

## Discussion

This study is the first investigation to use vertebrae to age wild caught Southern Stingrays. However, mortality rates, production rates, and growth models such as Von Bertalanffy growth function or a Gompertz function could not be generated due to the incomplete size range from the opportunistic collection method. Therefore, only age—at—width data were reported. Furthermore, while these results are unverified and not validated and should therefore be used with caution, previous studies on batoids suggest that opaque and translucent bands are formed annually (Cailliet and Goldman 2004, Natanson et al. 2007, Cicia et al. 2009).

Based on vertebral age counts, Southern Stingrays observed herein obtained relatively old ages (i.e., 17 years) and large sizes (i.e., 1127 mm DW), which are comparable to other large dasyatid species such as the Brown Stingray, *Bathytoshia lata* (maximum recorded age 24 years, maximum recorded DW 1790 mm, Basusta and Sulikowski 2012) and the Common Stingray, *Dasyatis pastinaca* (maximum recorded age 16 years, maximum recorded DW 1140 mm, Yigin and Ismen 2012). McEachran and Fechhelm (1998) and last et al. (2016) reported the maximum known size for Southern Stingrays to be 1500 mm DW, while Weigmann (2016) gave a maximum known size of 1640 mm DW. While direct comparisons cannot be made among stingray species, the Southern Stingray likely has similar life history characteristics to other similarly sized rays in the same family. These values are larger than the maximum size observed in the current study, which suggests that female Southern Stingrays are capable of obtaining larger sizes and older ages. Batoids obtain at least 70% of their maximum size when they reach maturity (Sulikowski et al. 2007, Cicia et al. 2009, Ebert and Cowley 2009), and the largest individuals in our study were gravid. This suggests that Southern Stingrays off southwestern Florida may reach a smaller maximum size than previously reported for the species.

While the maximum reported age in female Southern Stingrays raised in captivity since birth was younger (i.e., 13 years; Henningsen and Leaf 2010) compared to wild caught individuals herein (i.e., 17 years), the size of the 13—year—old captive stingray (1000 mm DW; A.D. Henningsen, pers. comm., National Aquarium, Baltimore, MD) was similar to the sizes recorded for wild stingrays at similar sizes in the

present study (1005 mm DW at 12 years, 910 mm DW at 13 years). The similar size of the known—age captive stingray and those of the present study suggest that the estimated ages presented herein are accurate, at least in the case of the larger rays examined. The age—at—width estimates provided herein are preliminary, and will lay the foundation for future studies on the age and growth of Southern Stingrays.

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