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TAIL SPINE CHARACTERISTICS OF STINGRAYS (ORDER MYLIOBATIFORMES) FOUND IN THE NORTHEAST ATLANTIC, MEDITERRANEAN, AND BLACK SEAS

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Abstract: Stingray tail spines, long known to be harmful, characteristics have long been ignored by ichthyologists. Examination of 12 of 14 species of stingrays found in the Northeast Atlantic, Mediterranean, and Black Seas (FAO fishing areas 27 and 37) revealed characteristics which can identify each species by spine alone. Characteristics are: total serrations on the spine, barbs on the spine base, total length (TL), base length, TL/base length percent, and other features. Spine serrations totals above 100 indicate an open water ocean species (*Dasyatis centroura* and *Pteroplatytrygon violacea, Aetobatis narinari*); 70+ a midwater species *(Dasyatis pastinaca,Pteromylaeus bovinus, Himantura uarnak*, and *Taeniura meyeni*); 50+ near substrate inhabitant (*Gymnura altavela, Myliobatis aquila, Dasyatis margarita*); 25-50 substrate species (*Taeniura grabata, Urogymnus ukpam*); below 25 a freshwater species. Insufficient data exists for *Rhinoptera marginata* and *Mobula mobular*. Significances of these results to ichthyologists and other fields will be discussed.

Key words: Stingrays, tail spines, *Dasyatis, Pteroplatytrygon, Aetobatis, Pteromylaeus, Himantura, Gymnura, Taeniura, Myliobatis, Urogymnus,* eastern north Atlantic, Mediterranean, Black Sea

INTRODUCTION

Man has been aware of stingrays and their venomous spines since Aristotle's (324-322 B. C.) Historia Animalium (Halstead 1970). New world central American peoples (Mayan, Incan, etc.) knew about stingray spines as early as 200-900 A. D. as they used them in genital and body mutilation rituals (Gann 1918; Tozzer in Baughman 1956; Benson 1988; Maxwell 2000). The earliest illustration of a stingray, with an exaggerated tail spine, was of the European common stingray, *Dasyatis pastinaca*, in Pierre Belon's De Aquatilibus Libri Duo published in Paris in 1553. Other early European papers by Grevin (1568) and Euphrarsen (1790) treated *D. pastinaca* and *Aetobatis narinari* respectively. Stingrays of the Adriatic were reported in Griffins Ictiologia Italiana, published about 1904 (Soljan 1948); that of the Black Sea by Svetovidov (1964). Halstead (1970) noting the distribution of 10 European, Mediterranean, and Black Sea stingrays, depicted spines of seven species: *D. pastinaca, P. violacea, P. bovinus, D. aspera* and *D. brevis* (= *D. centroura*), *Aetobatis narinari, Myliobatis aquila,* and *Rhinoptera marginata.* Other European distribution lists were by Hureau and Monod (1971) and Whitehead et al. (1984/1986) while Bigelow and Schroeder (1953) compared some western Atlantic stingrays related to European species, even including the doubtful Madeira butterfly ray, *Gymnura hirundo.* Soljan (1948) and Dulcic (2002) treated Adriatic species. Gudger (1914, 1943); and Halstead (1970) noted structure and occurrences of multiple spines, especially of the spotted eagle ray, *Aetobatis narinari*.

While the public is acutely aware of injuries resulting from stingray spines or that fishermen chop off stingray tails to keep from

being "stung" by a spine while sorting their fish catches, no one has seriously examined stingray spines to note their characteristics. Are spines bilaterally serrate; are they specific to a species; do spines reveal any relationship between stingray and the habitat; are spine characteristics useful? I report spine characteristics of 12 of 14 species of stingrays frequenting the eastern north Atlantic north off Madeira, Mediterranean, and Black Seas noting their distinct shape, number of serrations, presence or absence of serrations on the spine base, percent spine prebase/total length relationships, grooves, and other factors that distinguish each species. Spine information will link position of the stingray in the water column and if it will be useful to other fields of science.

METHODS

Stingrays examined were those captured in FAO fishing areas 27 and 37 of the eastern north Atlantic, Mediterranean, and Black Seas. Stingray spines were not detached from the tail to note, by sex and size (disk width), total length, prebase length (tip of spine to base attachment to tail, determined by placing a plastic ruler between spine and tail flush with its attachment to the tail); and base length (difference between total and prebase length). Spine serrations (right and left) are counts from the spine tip to the base of the spine (those on the base are counted separately). Skin overlapping the spine base should be teased away to reveal any serrations. Serration counts are based on the primary spine, not newly developing spine that may develop before or behind the primary spine attachment. Some species may have serrations on the base and/or extend into the prebase length. Note if a groove extends along the dorsal aspect of the spine. Spine tips may bend up or down.

OBSERVATIONS

***Dasyatis centoura*, roughtail stingray**: One of the largest stingrays (2.1 m disk width) occurring in the European eastern Atlantic from Norway south to Madeira, the Mediterranean, and Black Seas. Has been reported as *Trygon brucco* and *Dasyatis aspera*. A stingray with long wide tapering primary spines (males $\bar{x}$ = 149 mm total length (TL); female $\bar{x}$ = 154 mm). Spines are heavily serrated (total males $\bar{x}$ = 160, females $\bar{x}$ = 173, Table 1). Many small serrations occur laterally on the spine base. Spine prebase length (pb)/TL relationships range 78% males, 72% females. A deep groove dominates the length of the dorsal surface of the spine. Secondary spines form below the primary spines.

***Pteroplatyrygon violacea*, pelagic stingray**: A broad dark dorsally and ventrally anteriorly arch profiled 80 cm disk width stingray that was previously placed in the genus *Dasyatis*. The tail spine is slightly larger in males ($\bar{x}$ = 135 mm) than females ($\bar{x}$ = 132 mm, Table 1). Male spine serrations usually total 154, females 181. Ten to 25 serrations may occur on the spine base. Pb/TL relationships vary $\bar{x}$ = 72% in males and $\bar{x}$ = 75% in females. A dorsal groove may extend 20% down the spine length. The most distinguishing features of the even sided spine are the cul-de-sacs that occur between each serration medially (Fig. 1).

***Aetobatis narinari*, spotted eagle ray**: A 2.4 m wide stingray found in the eastern Atlantic that may possess up to eight serrated spines (one above the other) on its tail. Spine mean lengths are about 60 mm in males, 78 mm in females. Total spine serrations vary ~ 102 in males, 112 in females (Table 1). Up to 10 serrations per side may occur on the base. Pb/TL relationships are $\bar{x}$ = 76% in males, ≥

75% in females. A dorsal groove extends up to 50% of the spine length.

Fig. 1. Spine of the pelagic stingray *Pteroplatytrygon violacea* illustrating cul-de-sacs between each serration medially.

***Dasyatis pastinaca*, common stingray**: This 60 cm wide species, that has also been reported as *D. tortonese*, occurs in the eastern north Atlantic from Norway to Madeira, Mediterranean, and Black Seas. Spine length varies $\bar{x}$ = 67 mm in males, $\bar{x}$ = 64 mm in females (Table 1). Total spine serrations are ~ 98 in males, 74 females. Pb/TL relationships are 78% in males 64% in females. A dorsal groove extends up to 85% length of the spine. A 10-25 mm space occurs on each side of the base. Spine tip bends up.

***Himantura uarnak*, leopard stingray**: A very dangerous 125 cm disk wide recent immigrant from the Red Sea into the eastern Mediterranean off Israel and possibly Egypt (Basuta et al. 1998). Spine length averages ~ 63 mm in males, 55 mm in females. Total spine serrations average about 92 in males, 73 in females (Table 1). Pb/TL relationships are about 65% in males, 64% in females. Six to 12 serrations may occur on each side of the base. A groove extends 25% of the spine length.

***Myliobatis aquila*, common eagle ray**: An 83 cm disk wide stingray found in the eastern Atlantic from the southeastern North Sea to Madeira and all of the Mediterranean. Spine lengths average ~ 60 mm in males, 45 mm in females (Table 1). Total spine serrations average ~ 72 in males, 66 in females. Pb/TL percent average ~ 70% in males, 65% in females. A mid dorsal groove extends 10-40% of the spine length. A 2-23 mm space occurs along each side of the base.

***Taeniura meyeni*, fantail stingray**: A 180 cm stingray frequenting the Mediterranean and elsewhere. Spine lengths average ~55 mm in males, 89 mm in females. Total spine serrations are ~ 55 in each sex (Table 1). Pb/TL relationships are 71% in males, 75% in females. A 8-10 mm space may occur on each side of the base. A dorsal groove extends 80% of the spine length.

***Gymnura altavela*, spiny butterfly ray**: A 4 m wide species found in the eastern north Atlantic from Portugal to Madeira, Mediterranean, and Black Seas. Spine is short: ~23 mm in males, 33 mm in females (Table 1). Total serrations average about 54 in males, 55 in females. Pb/TL relationships are about 65% in males, 67% in females (Table 1). No serrations or spines on sides of base. Dorsal groove up to 55% spine length.

***Dasyatis margarita*, daisy stingray**: A medium large species (65 cm disk width) found in the eastern north Atlantic from Portugal to Madeira and the Mediterranean. Spine length about 40 mm in males, 45 mm in females. Total serrations ~ 52 in males, 64 in females (Table 1). Pb/TL relationships: 71% in males, 69% in females. Two to 6 mm spaces may occur on the base and onto the long narrow spine proper.

***Pteromylaeus bovinus*, bull ray**: A 180 cm wide species found in the eastern north Atlantic from Spain to Madeira, all of the Mediterranean, and Black Seas. Spine lengths average 32 mm in males, 61 mm in females. Total spine serrations ~ 30 in males,

59 in females (Table 1). Pb/TL relationships: males 56%, females 67%. A 4 mm space found on each side of spine base.

***Urogymnus ukpam*, pincushion stingray**: Formerly in the genus *Hemitrygon*, a large 65 cm wide species found in the eastern Atlantic that may enter freshwaters of Africa. Spine lengths range 48 mm in males, 59 mm in females (Table 1). Total serrations are ~ 59 in males, ~ 46 in females. Pb/TL relationships are: 55% in both sexes. A 10 mm space occurs on each side of the spine base.

***Taeniura grabata*, round fantail stingray:** A recent invader from the Red Sea found from Madeira, Italy, Turkey, and along the southern shore of the Mediterranean from Tunisia to Egypt (Biscoito and Wirtz 1994; Basuta et al. 1998; Serene et al. 1999). Total spine length: male, 50 mm, female, 66 mm; up at tip. New spines develop ahead of the primary spine. Total serrations: male 38, female 29-45. A one-to-25 mm space occurs on the base and extends onto spine proper. Pp/TL%: male 64%, female 85% (primary spine, secondary spine 52%). End of spine V-shaped. A dorsal groove extends 90% of spine length.

DISCUSSION

Fourteen species of stingrays that occur in the eastern north Atlantic, Mediterranean, and/or Black Seas (115 males, 140 females, Table 1) were examined. The existence of *Gymnura hirundo*, Madeira butterfly ray, is problematic. Lack of data, because of broken or incomplete spines, prevented detailed comments for two species: *Rhinoptera marginata* (Atlantic and Mediterranean), and *Mobula mobular* (Atlantic and Mediterranean).

All species exhibited right/left side variations in spine serrations (Table 1), typical of fishes (Hubbs and Hubbs 1945; Schwartz 2003). Males of four species: *D. pastinaca*, *M. aquila*, *H. uarnak*, and *U. ukpam* possessed more total spine serrations while six female species: *D. centroura, P. violacea, A. narinari, G. altavela, D. margarita*, *P. bovines,* and *T. grabata* possessed more total spine serrations (Table 1). Total spine serrations ranged from a high of 198 in *D. centroura* to a low of 12 in *G. altavela* (Table 1).

Interestingly, a total spine serration-species habitat frequenting relationship was discovered. Species with total spine serration of 100+ were oceanic or pelagic inhabitants. Species with total serrations of 70-100 were mid water swimmers. Species with 50-70 total spine serrations preferred benthic habitats. Species like *U. ukpam,* that frequent freshwaters, possess total spine serrations of 21-50. No evolutionary primitive to advanced species-spine relationship (*Dasyatis-Himintura-Gymnura-Myliobatis-Rhinoptera-Mobula)* was evident. The only European species with a very distinct spine characteristic was *P. violacea* with cul-de-sacs between serrations.

One can speculate that the two species with broken spines: *R. marginata* and *M. mobula* will have 50 and 35 total serrations respectively. Confirmation awaits adequate material. Meanwhile, injuries or attacks by five stingray species have been identified based only on their spines: *P. violacea* (Australia), *H. uarnak* (Red Sea, Spainer et al. 2000), *D. americana* (USA, McLellen et al. 1966), *M. californicus* (USA), and *H. chaophraya* (Thailand).

Spine characteristics will aid paleontologists compare fossil with recent forms and/or reveal how a species moved or invaded an area. Knowing a spine's identity will aid physicians in treating stingray wounds (Meyer 1997). No longer should we disregard stingray spines for they reveal much, and can be used to even describe a new species.

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Table 1. Distribution, variation R/L serrations, total serrations, spine length, prebase length (pb), pb/TL length %, presence of barbs or space or base for 114 males and 139 females of 11 species of stingrays frequenting the eastern Atlantic, Mediterranean, and Black Seas.

Species	n Sex	Distribution			Serrations (mean, range)			Spine $\bar{x}$ TL length (range) mm	Prebase length (pb)/TL (range)%	Barbs on base	% groove
		E.Atlantic	Mediterranean	Black Sea	R	L	Total				
Dasyatis centroura Roughtail stingray	27M 10F	X	X	X	$\bar{x}$ = 78 $\bar{x}$ = 90	$\bar{x}$ = 82 $\bar{x}$ = 88	160 178	$\bar{x}$ = 143 $\bar{x}$ = 159	78 72	Yes M Yes F	60-80 60-80
				M	17-119	20-116		30-182	58-88	20-116	
				F	58-118	72-114		109-198	62-82	72-114	
Pteroplatytrygon violacea Pelagic stingray	9M 15F	X	X	X	$\bar{x}$ =76 $\bar{x}$ =88	$\bar{x}$ = 78 $\bar{x}$ = 93	154 181	$\bar{x}$ = 135 $\bar{x}$ = 132	$\bar{x}$ = 72 $\bar{x}$ = 75	10-25	20
				M	59-197	50-189		111-173	64-77		
				F	59-197	57-156		75-161	69-92		
Aetobatis narinari Spotted eagle ray	5M 22F	X			$\bar{x}$ = 52 $\bar{x}$ = 62	$\bar{x}$ = 50 $\bar{x}$ = 50	102 112	$\bar{x}$ = 60 $\bar{x}$ = 78	$\bar{x}$ =76 $\bar{x}$ =75	10-10	50
				M	28-78	28-71		38-95	58-92		
				F	16-87	24-87		31-166	35-96		
Dasyatis pestinata Common stingray	13M 12F	X	X	X	$\bar{x}$ = 49 $\bar{x}$ = 40	$\bar{x}$ = 49 $\bar{x}$ =39	98 73	$\bar{x}$ = 67 $\bar{x}$ = 64	$\bar{x}$ = 71 $\bar{x}$ = 64	8-25 mm space	Up to 85
				M	30-70	32-67		36-119	59-76		
				F	24-71	23-80		31-113	57-78		
Himantura uarnak Leopard stingray	16M 20F		Eastern		$\bar{x}$ = 40 $\bar{x}$ = 36	$\bar{x}$ = 42 $\bar{x}$ =37	82 73	$\bar{x}$ = 63 $\bar{x}$ = 55	$\bar{x}$ = 63 $\bar{x}$ =64	6-12mm space	25
				M	23-87	35-77		41-120	55-92		
				F	17-65	16-101		30-94	48-71		

Continued

Species	n Sex	Distribution			Serrations (mean, range)			Spine $\bar{x}$ TL length (range) mm	Prebase length (pb)/TL (range)%	Barbs on base	% groove
		E.Atlantic	Mediterranean	Black Sea	R	L	Total				
Myliobatis aquila Common eagle ray	20M 17F	X	X		$\bar{x}$ = 38 $\bar{x}$ = 28	$\bar{x}$ = 34 $\bar{x}$ = 28	72 66	$\bar{x}$ =60 $\bar{x}$ =45	$\bar{x}$ = 70 $\bar{x}$ = 65	2-23 mm space	70
				M	25-56	23-56		45-83	58-90		
				F	13-60	10-56		15-80	47-81		
Taeniura meyeni, Fantail stingray	2M 5F		X		$\bar{x}$ = 33 $\bar{x}$ = 37	$\bar{x}$ = 26 $\bar{x}$ =32	59 59	$\bar{x}$ = 55 $\bar{x}$ = 87	$\bar{x}$ = 71 $\bar{x}$ = 75	5-10 serrations mm or space	80
				M	36-38	24-28		45-64	$\bar{x}$ = 61-76		
				F	14-47	14-53		47-87	$\bar{x}$ = 70-82		
Gymnura altavela Spiny butterfly ray	14M 24F	X	X	X	$\bar{x}$ = 25 $\bar{x}$ = 30	$\bar{x}$ = 28 $\bar{x}$ =32	53 62	$\bar{x}$ =23 $\bar{x}$ =33	$\bar{x}$ =69 $\bar{x}$ 67	No	Up to 55
				M	10-42	14-42		25-33	60-78		
				F	12-40	10-49		26-53	43-85		
Dasyatis margarita Daisy stingray	5M 4F	X	X		$\bar{x}$ = 26 $\bar{x}$ = 33	$\bar{x}$ = 26 $\bar{x}$ = 31	52 64	$\bar{x}$ = 43 $\bar{x}$ = 45	$\bar{x}$ = 71 $\bar{x}$ = 69	10-66 mm space	
				M	14-49	19-48		15-50	48-92		
				F	25-48	25-47		30-66	68-70		
Pteromylaeus bovinus Bull ray	1M 5F	X	X		$\bar{x}$ = 12 $\bar{x}$ = 38	$\bar{x}$ = 18 $\bar{x}$ = 31	30 57	$\bar{x}$ = 32 $\bar{x}$ = 61	$\bar{x}$ = 56 $\bar{x}$ = 67	7-63 mm space	no
				M	12	18		32	56		
				F	39-63	23-55		31-88	48-77		

Continued

Species	n Sex	Distribution			Serrations (mean, range)			Spine $\bar{x}$ TL length (range) mm	Prebase length (pb)/TL (range)%	Barbs on base	% groove
		E.Atlantic	Mediterranean	Black Sea	R	L	Total				
Urogymnus ukpam Pincushion ray	2M 5F	X			$\bar{x}$=25 $\bar{x}$=25		21 21	$\bar{x}$=56 $\bar{x}$=46	$\bar{x}$=55 $\bar{x}$=55	10-10 mm space	no
				M	25	21					
				F	25-38	21					
Taeniura grabata Round fantail stingray	1M				20	18	38	50	64	no	
	1F		X		S14 P22	15 27	29 49	44 66	52 85	1-25 mm spine on base	90%

S = secondary spine; P = primary spine