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Morphology of the Extrinsic Gasbladder Musculature
in the Golden Redfish, *Sebastes marinus*.

by

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ABSTRACT

The morphology of extrinsic gasbladder musculature of *Sebastes marinus* was examined to provide criteria that can be useful in discrimination of the three Northwest Atlantic redfishes, particularly for the smaller specimens (<25 cm) where the problem lies. The investigation revealed that *S. marinus* has a short, wide characteristic L-shaped gasbladder musculature which is generally tricipital. The most frequent pattern of tendon passage was the dorsal head tendons attached to ventral ribs, central head passing between ribs 2-3 and ventral head passing between ribs 3-4. This is significantly different from the long, narrow gasbladder muscle of beaked redfishes with a passage between ribs 2-3 for *S. mentella* and between ribs 3-4 for *S. fasciatus*.

INTRODUCTION

The classification of redfishes (*Sebastes* spp.) in the Northwest Atlantic is not completely understood. External morphological differences permit the separation of *S. marinus* from beaked redfishes, *S. mentella* and *S. fasciatus* (Templeman and Sandeman 1957). However, a problem lies in identifying the smaller specimens (<25 cm) because morphological characters used in differentiating them may not be as well defined. Ni (1981) reported the route of passage of the extrinsic gasbladder muscle was the most useful morphological character for discriminating between *S. mentella* and *S. fasciatus* and concluded that the passage was between ventral ribs 2-3 for *S. mentella* and between 3-4 or 4-5 for *S. fasciatus*. The purpose of this research was to examine the morphology of the extrinsic gasbladder musculature of *S. marinus* to provide criteria that can be useful in discriminating the three Northwest Atlantic redfishes.

Hallacher (1974) examined the morphology of the extrinsic gasbladder musculature for 82 species of rockfishes and found a few species can be separated by having a species-specific morphology. In an addendum to his article he reported that William Eschmeyer had examined additional specimens of North Atlantic redfish and concluded that the gasbladder muscle passes between ribs 2-3 in *S. marinus* and 3-4 in *S. fasciatus*, thus reclassifying specimens with ventral ribs 3-4 that Hallacher had previously called *S. marinus* to be *S. fasciatus*. Litvinenko (1980) also reported that *S. marinus* has a tendon attached to the second rib which is characteristic of this species. This study revealed that the extrinsic gasbladder musculature in *S. marinus* has a characteristic L-shape that is generally tricipital (three heads) with a variety of patterns of tendon passage which are different with that of *S. mentella* and *S. fasciatus*.

MATERIALS AND METHODS

There were 30 specimens of *S. marinus* collected during research cruises from NAFO Divisions 3M in February and 3Ps in June, 1982, at depths between 147-262 m. Fork length ranged from 23 to 54 cm. Specimens were orange or yellowish red in color, with relatively small eyes, and with a blunt, bony extrusion of the lower jaw (Templeman and Sandeman 1957). Specimens were frozen, thawed prior to measurement and dissection, and then preserved in 10% Formalin.

The extrinsic gasbladder musculature was exposed by dissection as described in Hallacher (1974). All specimens had a pair of gasbladder muscles one on each side of the body in the area of the midline just posterior to the operculum. In preliminary dissections no structural differences were observed between two sides, therefore, subsequent examination was on the left side (Fig. 1).

In the text tricipital refers to three heads of the extrinsic gasbladder muscle, A trifurcation refers to a three branched tendon from a head of the muscle.

RESULTS

The origin of the extrinsic gasbladder muscle is on the occipital region of the cranium. The muscle extends on an angle posteriorly to the supracleithrum where it has a second smaller origin. From this origin dorsally there is a myosepta. The muscle has a characteristic L-shape from the myosepta posteriorly (Fig. 2) and it is this section of the muscle proper that had multiple heads.

Specimens had either tricipital (86.7%) or tetracipital (13.3%) gasbladder muscles. The most ventral head was frequently the largest with reduction in head size dorsally. The tendons attached to the heads also followed this sequence in size.

Patterns of tendon passage varied from specimen to specimen (Table 1). The pooling of data for similar muscle heads revealed that the dorsal heads had 61.5% of 52 tendons attached to rib 2 and 28.8% attached to rib 3. The central heads had 75.4% of 69 tendons passing between ribs 2-3 and 23.2% attached to rib 3. The ventral muscle heads had 36.0% of 50 tendons passing between ribs 2-3 and 64.0% between ribs 3-4.

The most frequent pattern of tendon passage when considering the majority of tendons from a muscle head was the dorsal head tendons attached to rib 2, central head passing tendons between rib 2-3 and the ventral head passing tendons between 3-4 (Table 2). The average number of tendons was 5.50 for tricipital muscles and 6.00 for tetracipital muscles (Table 3). Insertions of tendons were generally on vertebral parapophyses 7-9 for central and ventral muscle heads and on ribs 2 or 3 for dorsal heads (Table 4, Fig. 3).

DISCUSSION

There were no observed differences due to depth or areas but additional data from other areas (e.g. Subarea 1) should be considered in future. S. marinus appears to exhibit a variety of patterns by the extrinsic gasbladder muscle with regards to the number of tendons and the passage of those tendons between (or attached to) ribs from the 30 specimens dissected. However, the extrinsic gasbladder muscle of S. marinus differs greatly from S. mentella and S. fasciatus which have been described as a long, narrow and thin muscle and have tendon passage between ventral ribs 2-3 and 3-4 respectively. S. marinus was observed to have a short, wide tricipital or tetracipital muscle with tendon passage frequently between ventral ribs 2-3 and 3-4, and an attachment of dorsal muscle head usually on ventral rib 2 or 3. This is a unique character in discriminating small, ambiguous redfish specimens.

The number of tendons extending from the gasbladder muscle was generally six (with mean values 5.50 for tricipital muscles and 6.00 for tetracipital muscles). A comparative study with specimens of S. mentella and S. fasciatus that indicated the number of tendons from the gasbladder muscle of those species was 1 to 2 and 2 to 3 respectively. Thus, the number of tendons generally decreases in the series from S. marinus, then S. fasciatus to S. mentella. This reverses the results of Litvinenko (1980) who reported that S. marinus gasbladder muscles had less tendons in general than S. fasciatus.

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Table 1. Patterns of gasbladder muscle tendon passage in *Sebastes marinus*. T_d, T_c, T_v are the single tendon from a dorsal, central, ventral muscle head respectively. 2T, 3T are bifurcated, trifurcated tendons respectively. Superscripts are vertebra number or rib (with r) to which tendon inserts, x represents damaged. Tendons attaching directly to ribs are listed in the column directly under rib number, those passing between ribs listed directly between rib numbers.

Fork length (cm)	Depth (m)	Sex	Ventral rib					
			1	2	3	4		
51 ^a	191	M			3T _c ^{8,8,r4}	2T _d	T _v ⁹	
36	203	M		T _d T _{cu}	2T _{cl} ⁸ T _v ⁹			
47	262	F		2T _d	2T _v ⁶	2T _c	T _v ⁷	
28	220	M		2T _d	x x 3T _c T _v		x T _v	
38	220	F		T _d	2T _c ^{7,x}		T _v ⁸	
54	159	M			T _c ⁷	2T _d	2T _v ^{5,8}	
30	151	M			T _d ⁶ 2T _c ⁷		3T _v ⁸	
33	203	M		T _d	2T _c ^{7,8} T _v ⁹		T _v ⁹	
35	203	M		T _d	2T _c ⁶	T _d	2T _v ⁷	
33	203	M		T _d	2T _c ⁸	T _d	2T _v ⁹	
36	203	M		2T _d	2T _c ⁸ 2T _v ⁹	T _d		
38	203	M		T _d	3T _c ⁸ T _v ⁹	T _d	2T _v ⁹	
48	262	F		T _d	2T _c ⁸ T _v ⁹			
52	262	F		2T _d	2T _v ⁷	T _c		
37	203	M		T _d	T _d ⁷ 2T _c ⁸	T _c	T _v ⁹	
35	203	F		T _d	3T _{cl} ^{r4,8,8}	T _{cu}	2T _v ⁹	
41	262	M		2T _d	T _{cu} ⁷ T _{cl} ⁸		T _v ⁹	
51	159	F			2T _c ⁷	2T _d	2T _v ⁸	
54	191	F			T _c ⁸ T _v ⁹ T _d ⁷	T _d		
49	159	M			T _c ⁸ T _v ⁹	2T _d	T _v ⁹	
43	159	F			3T _c ⁸	T _d	2T _v ⁹	
54	191	F				T _d T _c	T _v ⁹	T _c
46	159	M		2T _d	2T _{cl} ⁸	2T _{cu}	T _v ⁹	
47	191	M		T _d	2T _c ^{7,8} T _v ⁹	T _c		
34	159	F		T _d		2T _c	2T _v ⁸	
35	262	M		2T _d	2T _c ⁷ T _v ⁸			

Table 1. (Cont'd.)

Fork length (cm)	Depth (m)	Sex	Ventral rib			
			1	2	3	4
45	191	F	T _d	T _c ⁸ T _v ⁹	T _c	T _v ⁹
49	159	M	2T _d	T _c ^x 2T _v ^x		
41	159	F	2T _d	T _c ⁷	3T _c	T _v ⁸
46	220	F	2T _d	3T _c ^{r₄, r₄^x}		T _v ^x

^a: specimen as shown in figures.

Table 2. Summary of gasbladder muscle tendon passage in *Sebastes marinus* by considering where passage of the majority of tendons (or in some cases the largest) and branches occurred. Tendons from muscle heads listed directly under a ventral rib are attached to the rib.

Ventral rib ^a					Frequency
1	2	3	4		
	D	C		V	9
	DC _u	C _l V			1
	D	V	C		2
		C	D	V	4
		DC		V	1
	D	CV			5
	D	C _l	C _u	V	2
	D	C _l C _u		V	1
		CV	D		1
			DC	V	1
	D		C	V	2
		DCV			1

^aD = Dorsal; C = Central, C_u = Central Upper, C_l = Central Lower; and V = Ventral Muscle Heads.

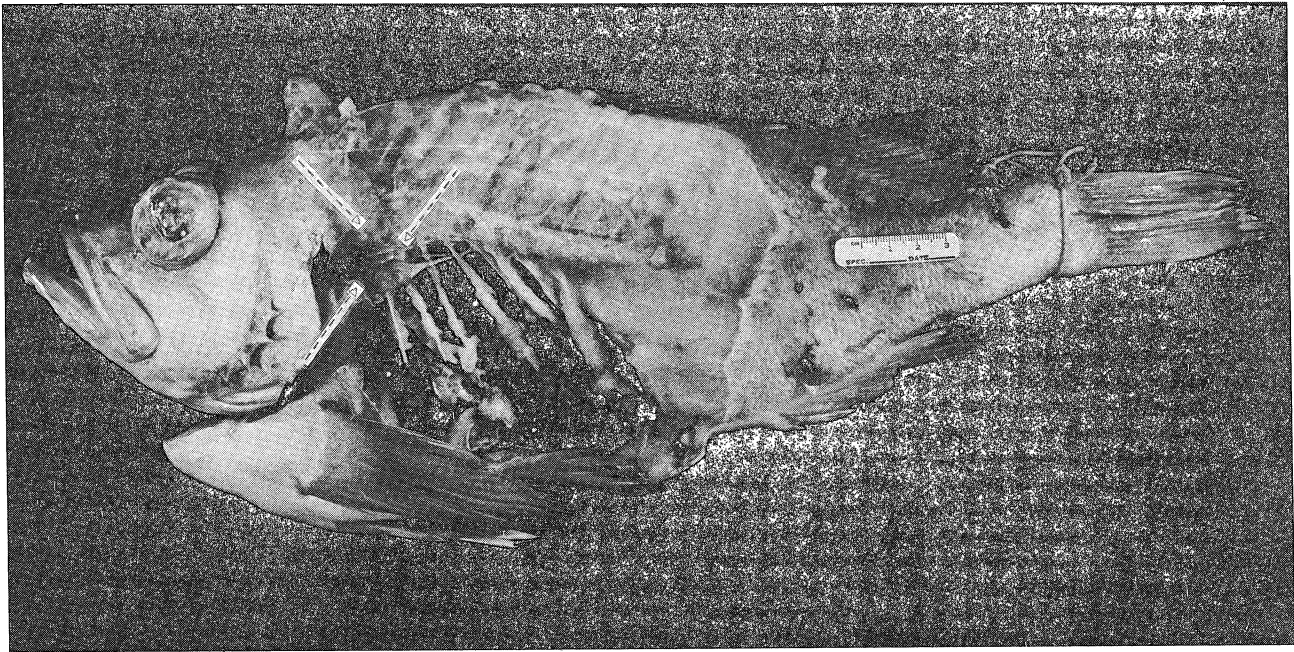


Fig. 1. *Sebastes marinus* (51 cm, male) showing relative position of extrinsic gasbladder muscle. Muscle was separated from myospeta and shows typical L-shaped appearance.

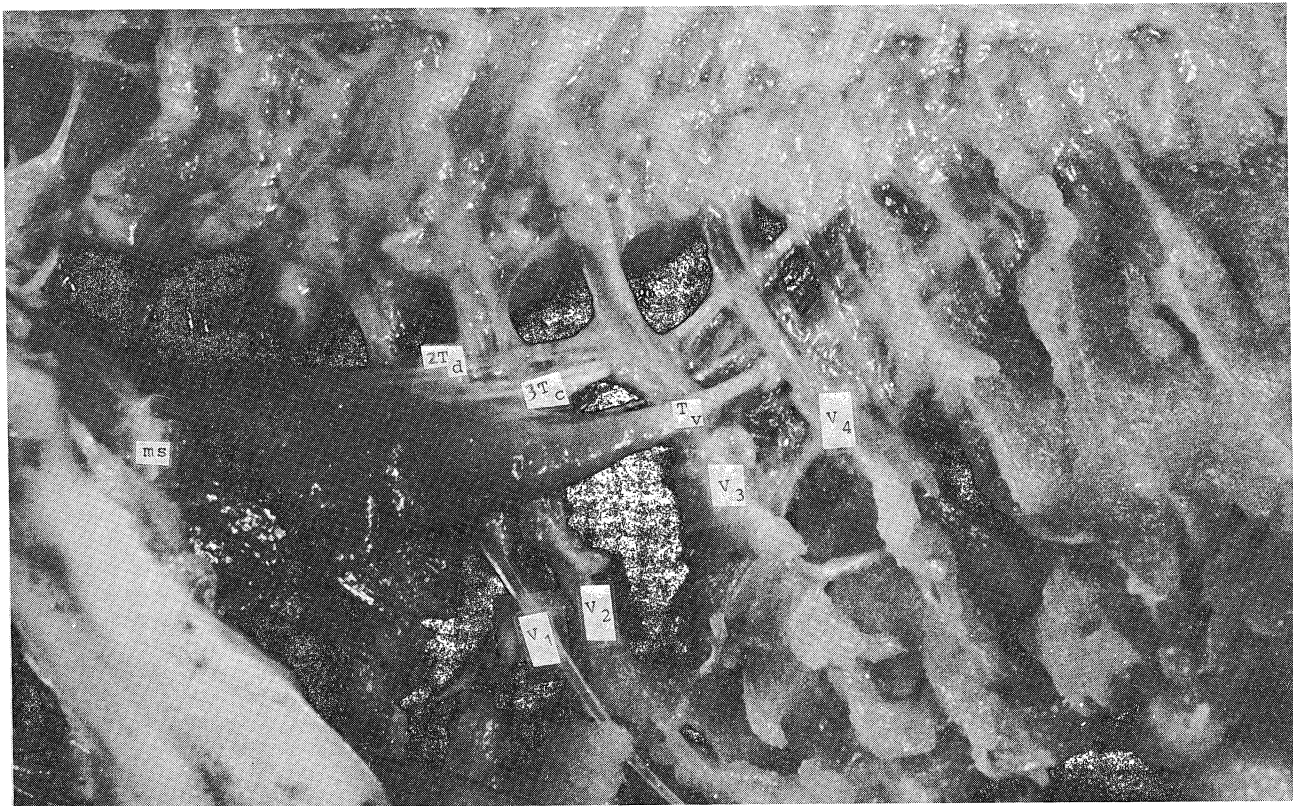


Fig. 2. Extrinsic gasbladder muscle of *Sebastes marinus* showing tendons coming from each of the muscle heads. Muscle was separated from myosepta (MS) to see characteristic L-shape more clearly. Muscle heads (three here) can be easily distinguished as there are three different levels of the muscle proper where tendons extend posteriorly from the muscle T_d , T_c , T_v are tendon from dorsal, central and ventral muscle heads respectively. V_1 , V_2 , V_3 and V_4 are ventral ribs.

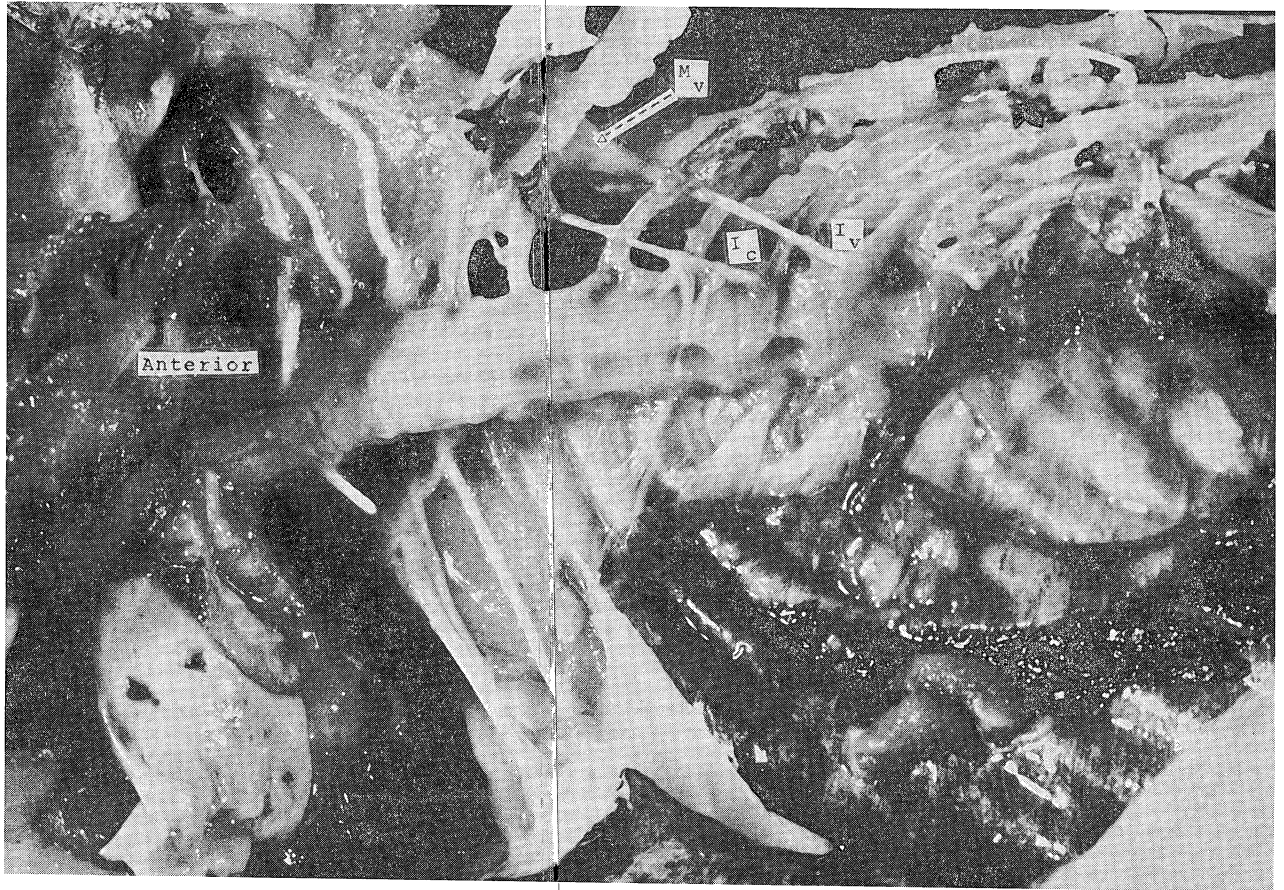


Fig. 3. Ventral view of the vertebral column of Sebastes marinus showing insertion points of tendons from the central (I_c) and ventral (I_v) muscle heads. The tendon from the central head inserts on the parapophysis of the 8th vertebra and the tendon from the central muscle head inserts on the parapophysis of the 9th vertebra.

