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Seperation of sharp beaked redfish, Sebastes fasciatus and S. mentella, by the morphology of extrinsic gasbladder musculature

by

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INTRODUCTION

The classification of the Northwest Atlantic redfish has been somewhat confused in the past. This report is an attempt to separate Sebastes fasciatus from S. mentella by examining the morphology of extrinsic gasbladder musculature.

A form of sharp beaked redfish other than S. mentella was first detected by Barsukov (1968). This different form had been briefly described more than a hundred years ago on the basis of only one young specimen amd so retained the old name S. fasciatus Storer 1856. Barsukov (1972) listed some basic distinctive features of the Atlantic Sebastes sp., but confessed that it was impossible to distinguish the rosefish, S. fasciatus, from the sharp beaked redfish, S. mentella, by their external appearance. Although Barsukov and Zakharov (1972) developed a key for redfish, they admitted that all of the external characteristics were difficult to detect by eye and required considerable skill. Therefore, the key for redfish needs to be refined and simplified. Litvinenko (1974) found the nature of coloration may serve as a control character in identification of these two different types of sharp beaked redfish in the juvenile stage. Ni [1980] examined 46 morphological characters, individually and collectively, and concluded that S. fasciatus can be distinguished from S. mentella if morphological characters are combined rather than used singly. The results of discriminant analysis demonstrated that there were two significant morpholgical different groups of sharp beaked redfish, and also, determined that anal fin rays, caudal peduncle dorsal length, relative position of pectoral and pelvic fin to anus, the fusion of occipital-nuchal ridge, etc. were good discriminators between S. fasciatus and S. mentella in the classification function. However, all these studies could not distinguish these two different types of sharp beaked redfish by one clear cut single character, since the nature of coloration as the control factor for separating juveniles is rather subjective.

Hallacher (1974) examined the extrinsic gasbladder muscles of 82 species of rockfishes and found few species can be separated from other rockfishes on the basis of species-specific characteristics of their gasbladder muscles. He also reported in his addendum that William Eschmeyer examined few specimens of North Atlantic redfish and found two structural conditions existed. The gasbladder muscles passed between ventral ribs 2-3 in S. mentella and S. marinus, and between 3-4 in S. fasciatus and S. viviparus.

This study was to compare the morphology of extrinsic gasbladder musculature between S. mentella and S. fasciatus in addition to their external multivariate morphological studies (Ni 1980) on the same 200 sharp beaked redfish specimens. The characteristics of gasbladder musculature were found significant different and can be served as the prime single discriminator between S. fasciatus and S. mentella.

MATERIALS AND METHODS

During a research cruise in 1973, 200 specimens of sharp beaked redfish were collected by L. S. Parsons from eastern Grand Bank. Breakdown of the specimens into groups were based on anal fin ray counts, fusion of head spines, etc. 100 S. fasciatus have standard length range 100-250 mm and 100 S. mentella range 188-377 mm. For sample details refer to Ni [1980].

All fish were frozen, thawed prior to measurement, and preserved in 10% Formalin after dissecting. (Examination of the specimens may be arranged by writing the author).

The left extrinsic gasbladder muscle was exposed for examination by dissection. These muscles appeared to have arisen from the ventral fibers of the epaxialis (the dorsal half of the lateral body musculature). All specimens had a pair of muscles, one on each side of the midline. The pair extended posteriorly from their origin on the occipital region of the cranium along the gasbladder to the vertebral parapophyses where they attached by means of tendons or ligaments.

In preliminary dissections, each of the muscle pair was examined with no structure differences being observed. All subsequent dissections were made with only the muscle on the left side being examined. A large patch of skin was removed, its perimeter extending along the rear of the cranium and pectoral girdle, posteriorly along the base of the dorsal fin to its end, downward to the ventral half of the fish's side and forward to the pecliv fin axil. All exposed muscle tissues lying dorsal and upper to the left dorsal ribs were removed. The left gasbladder muscle was exposed to view by gently breaking away the dorsal ribs. Care was taken while removing the first two or three dorsal ribs since the gasbladder muscle lies just ventral to them (Fig. 1).

Once the gasbladder muscle was exposed, all skeletal muscle tissues surrounding it were plucked away cautiously to expose the muscle from its point of origin on the cranium to its points of inserton on the vertebral parapophyses. The insertion points were determined by clearing away all intercostal muscle between the ventral ribs. Once the first nine or ten ribs were exposed, the dense tendon tissue of the gasbladder muscle was seen extending laterally just under the ribs. The body cavity was examined from the ventral side with the viscera and the gasbladder removed. The whitish tendons (or ligaments) were then followed to their ponts of insertion on the vertebral parapophyses (Fig. 2).

RESULTS

Dissections of 200 specimens of sharp beaked redfish revealed significant differences between S. fasciatus and S. mentella in gross morphology of the extrinsic gasbladder musculature. Particular attention was given to the location of passage of the gasbladder muscle through the ventral ribs and insertion points on the parapophyses of vertebrae. No sexual dimorphism or size related pattern in the characterisitcs of extrinsic gasbladder musculature was noted. The striated muscle tissue passed under the 2nd or 3rd ribs and usually terminated in one to three tendons.

S. fasciatus (Fig. 3)

The extrinsic gasbladder muscles of S. fasciatus specimen were long, thin and narrow with uniform width except for a small ventral projection about midway between the origin and the point of passage through the ventral ribs. This ventral projection with its ligament attached to the central surface of the cleithrum bone of the pectoral girdle. A white ligament (Baudelot's ligament) passed this point of attachment dorsally and attached to the occipital bone. Table 1 displays the gasbladder muscle of S. fasciatus giving route through the ventral ribs and insertion points on the parapophyses of vertebrae. For passage between ribs, large T's refer to main muscles or tendons, small t's to minor tendons. For point of insertion large L's refer to ligaments from main tendon, small ℓ's to ligaments from minor tendon. Of 100 specimens examined, 94% of S. fasciatus had the main tendon passing through between 3-4 ventral ribs, 5% passing through 4-5 ventral ribs, and 1% having bifurcated tendons through 3-4 and 4-5 (Table 3). Large number of small tendons were observed; 38% of the 100 specimens had small tendons passing through 2-3, 8% passing through 3-4, 7% passing through 4-5, and 1% passing through 5-6. Large variations were also found for insertion points for ligaments on vetrebrae. Usually, there were three ligaments from main tendon attached to the 8, 9 and 10 vertebrae respectively. The range of vertebrae of which tendon inserts is from the 5th to the 12th. The number of ligaments ranged from 1(1%) to 4(20%).

S. mentella (Fig. 4)

The characteristics of the gasbladder muscle of S. mentella were generally similar to the overall description of those found in S. fasciatus: the muscle was long, narrow and thin; the muscle originated from the occipital region of the cranium and attached to the pectoral girdle as it passed posteriorly to insert by means of ligament on the vertebral parapophyses. However, the following differences were observed (Table 2): of 99 specimens (excluding one damaged), all had the main tendon passing through between 2-3 ventral ribs, with 6 specimens having bifurcated tendons and passing through 2-3 and 3-4; a smaller number of small tendons (only 8%) were found; fewer ligaments from main muscle were noticed, a single ligament being a dominant phenomenon (55%), and inserting mainly on the 7th vertebra. The range of vertebrae of which tendon inserts is from the 4th to the 9th. The number of ligaments range from 1 (54%) to 3 (4%).

DISCUSSION

In all 200 specimens of sharp beaked redfish examined, the characteristics of extrinsic gasbladder muscle showed clear differences between S. fasciatus and S. mentella. First, the gasbladder muscle of S. fasciatus passes between 3-4 (94%) or 4-5 (5%) ventral ribs, while the muscle of S. mentella passes between 2-3 ventral ribs. Second, S. fasciatus had a greater number of minor tendons extended from the gasbladder muscle than S. mentella. Finally, S. fasciatus most commonly had three ligaments which inserted mainly on 8, 9 and 10 vertebrae whereas S. mentella mainly has only one ligament which inserted on the 7th vertebra.

Although significant differences in the characteristics of gasbladder muscle were found, few remarks should be made. This technique is very time consuming and requires special skills. Therefore, it is impossible to apply in field surveys to seperate sharp beaked redfish. The more feasible method is to utilize external characters as suggested by Ni [1980]. Only ambiguous specimens need to be dissected. A preliminary study of 9 S. marinus specimens indicated another form of extrinsic muscle for redfish. S. marinus seemed to have a short, wide and bifurcated gasbladder muscle, passing routes are between 2-3 and 3-4 ventral ribs. However, this finding must be verified by further dissections, as this result differs from that of Eschmeyer (Hallacher 1974). Further efforts were made to back check the sharp beaked redfish which has bifurcated muscle (one in S. fasciatus and six in S. mentella), there is no indication of misclassification for these 7 sharp beaked redfish specimens.

In conclusion, the route passing through ventral ribs of the extrinsic gasbladder muscle is the best discriminator for sharp beaked redfish among all the morphological characters investigated. It passes between 2-3 ventral ribs in S. mentella and between 3-4 or 4-5 ventral ribs in S. fasciatus.

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Table 1. Gasbladder muscle of S. fasciatus giving route through the ventral ribs and insertion points on the parapophyses of vertebrae. For passage between ribs, large T's refer to main muscles or tendons, small t's to minor tendons. For point of insertion, large L's refer to ligaments from main tendon, small ℓ's to ligaments from minor tendon.

Sp. No.	Sex	Standard length (mm)	Ventral ribs through which muscle/tendons pass					Vertebrae on which ligament insert								
			1-2	2-3	3-4	4-5	5-6	4	5	6	7	8	9	10	11	12
1	♂	185		t	T							ℓ	L	L		
2	♀	193			T								L	L		
3	♀	201		tt	T						ℓ	ℓ	L	L		
4	♀	173			T							L	L	L		
5	♀	198			T							L	L	L		
6	♂	183		t	T							ℓ	L	L		
7	♀	174			T	t						ℓ	L	L		
8	♀	204		t	T						ℓ	L	L	L		
9	♀	188			T								L	L		
10	♀	166			ttT	T					ℓ	ℓ	L	L		
11	♀	190		t	T							ℓ	L	L		
12	♀	181			T								L	L		
13	♂	174		t	T					ℓ			L	L	L	
14	♀	164		t	T								ℓ	L		
15	♀	191		t	T						ℓ	L	L			
16	♀	181				T							L	L		
17	♂	169			T							L	L	L		
18	♀	194		t	T						ℓ			L		
19	♂	166		t	T							ℓ	L	L		
20	♂	184			t	T								L	L	
21	♂	199			tt	T						L	ℓ	ℓ		
22	♀	175		t	T							ℓ	L	L		
23	♂	186		t	t	T	t				ℓ	ℓ	L			
24	♀	176			T								L	L		
25	♂	175		t	T						ℓ	L	L	L		
26	♂	199			T								L	L		
27	♂	187			T	t						ℓ	L	L		
28	♀	198			T							L	L	L		
29	♂	176			T								L	L		
30	♂	185			T	t					ℓ	L	L	L		
31	♂	211			T						L	L	L			
32	♂	173		t	T						ℓ	L	L	L		
33	♀	172			T	t					ℓ	L	L	L		
34	♀	196			T							L		L		
35	♀	182			T						L	L	L			
36	♀	179			T								L	L		
37	♀	173		t	T								ℓ	L		
38	♀	176			T								L	L		
39	♂	188			t	T					ℓ	L	L			
40	♀	185			T					points of inserton damaged						
41	♂	186			T							L	L	L		
42	♀	215		t	T	t					L	L	L			
43	♀	174			tT							L	L	L		
44	♀	218			tT							LL	L	L		
45	♂	160			T							L	L	L		
46	♀	188			T							L	L	L		
47	♀	185			tT							L	L	L		
48	♀	187			T							L	L	L		
49	♂	183			T							L	L	L		
50	♀	195			T	t						L	L	L		
51	♂	169			T							L	L	L		
52	♀	187		t	T							L	L	L		
53	♀	169			T							L	L	L		
54	♂	182			T							L	L	L		
55	♂	193			T					L	L	L				
56	♀	195			T								L	L		
57	♂	187		t	T						ℓ	L		L		

Table 1 (Cont'd).

Sp. No.	Sex	Standard length (mm)	Ventral ribs through which muscle/tendons pass 1-2	2-3	3-4	4-5	5-6	Vertebrae on which ligament insert 4	5	6	7	8	9	10	11	12
58	♀	208			T								L	L		
59	♀	186		t	T						ℓ	L	L	L		
60	♂	192			T							L	L	L		
61	♀	192		t	T						ℓ		L	L		
62	♂	184		t	T							ℓ	L	L		
63	♀	170			T								L	L		
64	♂	174		t	T							ℓ	L	L		
65	♀	222			T							L	L	L		
66	♂	187			T						L	L	L	L		
67	♂	169		t	T					ℓ	L	L	L			
68	♂	191			T							L	L	L		
69	♀	197		t	T						ℓ		L	L		
70	♀	178		t	T	t				ℓ		L	L	L		
71	♀	186		t	T					ℓ	L	L	L			
72	♂	194		t	T					ℓ	L	L	L			
73	♂	173		t	T							L	L	L		
74	♂	177		t	T							L	L	L		
75	♀	179			T						L	L	L			
76	♀	193		t	T						L	L	L			
77	♂	195		t	T						ℓ		L	L		
78	♂	182		t	T					ℓ	L	L	L			
79	♀	198		t	T					ℓ	L	L	L			
80	♀	259		t	T				ℓ		L	L	L			
81	♀	213			T								L	L		
82	♀	187		t	T							ℓ	L	L		
83	♂	233		t	T						ℓ	L	L	L		
84	♀	185			T								L	L		
85	♀	178			T							L	L	L		
86	♀	223		t	T							L	ℓL	L		
87	♀	241			T							L	L			
88	♂	190			T								L	L		
89	♂	258		t	T							ℓ	L	L		
90	♀	186			T									L	L	L
91	♂	183			T								L	L		
92	♀	194			T							L	L	L		
93	♀	182			T							L	L	L		
94	♀	186			T								L	L		
95	♀	182			T									L		
96	♂	183			T							L	L	L		
97	♂	183			T							L	L	L		
98	♂	174			T								L	L		
99	♀	190			T								L	L		
100	♀	173			T								L	L		

Table 2. Gasbladder muscle of <u>S</u>. <u>mentella</u> giving route through the ventral ribs and insertion points on the parapophyses of vertebrae. Abbreviations are the same as in Table 1.

Sp. No.	Sex	Standard length (mm)	Ventral ribs through which muscle/tendons pass 1-2	2-3	3-4	4-5	5-6	Vertebrae on which ligament insert 4	5	6	7	8	9	10	11	12
101	♀	216		T							L	L				
102	♂	188		T							L	L				
103	♂	213		T						L	L	L				
104	♂	224	T	T						L	L					
105	♂	211		T				point of insertion damaged								
106	♀	214		T							L					
107	♀	220		T							L					
108	♂	237		T							L					
109	♂	239		T							L					
110	♂	236		T							L					
111	♂	241		T							L					
112	♀	281		T							L					
113	♂	314		T						L	L					
114	♂	241		T							L					
115	♀	210		T							L					
116	♂	203		T							L					
117	♂	213		T	T						L	L				
118	♂	215		T							L					
119	♂	241		T							L					
120	♀	225		T						L	L					
121	♀	224		tendon torn				point of insertion damaged								
122	♂	236		T							L					
123	♂	206		T							L					
124	♀	218		T							L					
125	♂	230		T							L					
126	♂	212		T							L					
127	♀	230		T							L					
128	♂	240		T							L					
129	♀	211		T							L					
130	♂	205		T						L	L	L				
131	♂	189		T							L					
132	♂	232		T							L					
133	♂	239		T							L					
134	♂	237		T							L					
135	♀	250		T							L	L				
136	♀	246	t	T						ℓ	L					
137	♂	235		T							L					
138	♂	246	t	T							ℓL					
139	♀	285		T						L		L				
140	♂	246		T							L	L				
141	♂	247		T						L	L					
142	♀	229		T							L					
143	♀	245		T							L					
144	♂	232		T							L					
145	♀	246		T							L	L				
146	♂	267		T							L					
147	♀	241		T							L					
148	♀	259		tT	T					ℓ		L	L			
149	♀	268		T							L					
150	♂	287		T							L					
151	♀	292		T							L	L				
152	♀	281		T							L	L				
153	♂	292		T							L	L				
154	♀	279		T							L					
155	♂	309		T							L					
156	♂	251		T							L					
157	♀	207		T							L					

Table 2 (Cont'd).

Sp. No.	Sex	Standard length (mm)	Ventral ribs through which muscle/tendons pass					Vertebrae on which ligament insert								
			1-2	2-3	3-4	4-5	5-6	4	5	6	7	8	9	10	11	12
158	♂	316		T							L	L				
159	♀	373		T						L	L					
160	♀	262		T							L					
161	♂	285		T							L	L				
162	♀	334		T							L					
163	♀	297		T								L				
164	♂	339		T							LL					
165	♀	344		T						L	L					
166	♂	377		T						L	L	L				
167	♀	295		T							L					
168	♂	280		T								L				
169	♀	310		T							L	L				
170	♂	339		tT							L					
171	♂	329		T							L					
172	♀	322		T							L	L				
173	♂	346		T							L					
174	♀	360		T							L					
175	♂	343		T							L	L				
176	♂	361		T							L					
177	♀	355		tT							L					
178	♂	364		T							L					
179	♂	298		T	T						LL					
180	♀	282		T							L					
181	♂	270		T							LL					
182	♀	271		T							LL					
183	♀	281		T								LL				
184	♂	267		T								L				
185	♀	294		T							L					
186	♀	309		T	T						L	L				
187	♀	306		T							L	L				
188	♂	328		T							L					
189	♂	346		T				L		L						
190	♀	377		tT				ℓ			L					
191	♂	256		T							LL					
192	♂	245		T							L					
193	♀	256		T							LL					
194	♂	260		T							L					
195	♂	274		T							L	L				
196	♂	305		T							L	L				
197	♀	304		T						L	L					
198	♂	310		T							L					
199	♀	305		tT	T					ℓ	L	L				
200	♂	348		Tt						L	L					

Table 3. Patterns and frequency of gasbladder muscle of S. fasciatus and S. mentella giving route through the ventral ribs. For passage between ribs, large T's refer to main muscles or tendons, small t's to minor tendons.

Species	Patterns of ventral ribs through which muscles/tendons pass					Frequency	Percentage (%)
	1-2	2-3	3-4	4-5	5-6		
			T			49	49
Sebastes		t	T			34	34
fasciatus		tt	T			1	1
			tT			3	3
		t	T	t		2	2
			T	t		5	5
			ttT	T		1	1
			tt	T		1	1
			t	T		2	2
				T		1	1
		t	t	T	t	1	1
Sebastes		T				87	87.88
mentella	T	T				1	1.01
	t	T				2	2.02
		tT				4	4.04
		T	T			3	3.03
		tT	T			2	2.02

Figure Captions

Fig. 1. Exposed left extrinsic gasbladder muscle.

Fig. 2. Ventral view of gasbladder muscle showing route through ventral ribs and pionts of insertion on the parapophyses of vertebrae.

Fig. 3. Extrinsic gasbladder muscle of S. fasciatus passing through between 3rd and 4th ventral ribs.

Fig. 4. Extrinsic gasbladder muscle of S. mentella passing through between 2nd and 3rd ventral ribs.

Fig. 1.

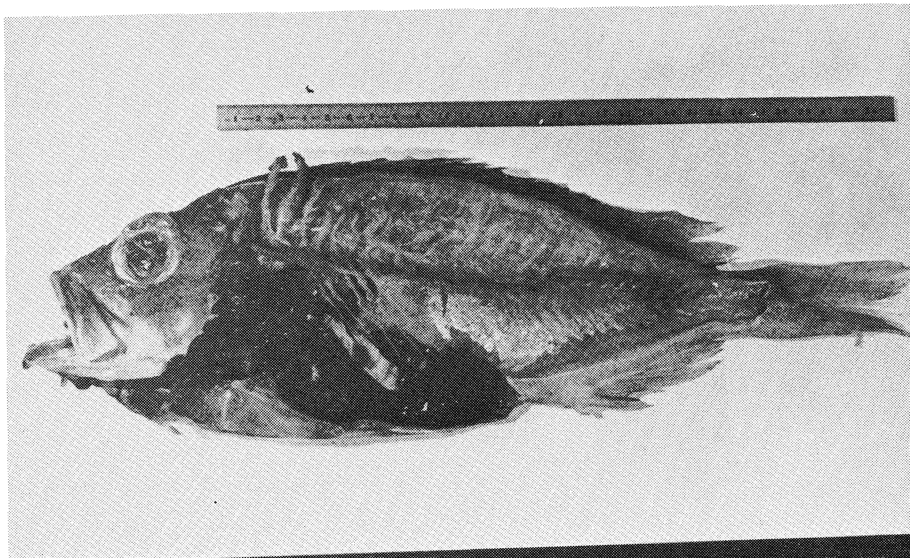

Fig. 4.

Fig. 3.

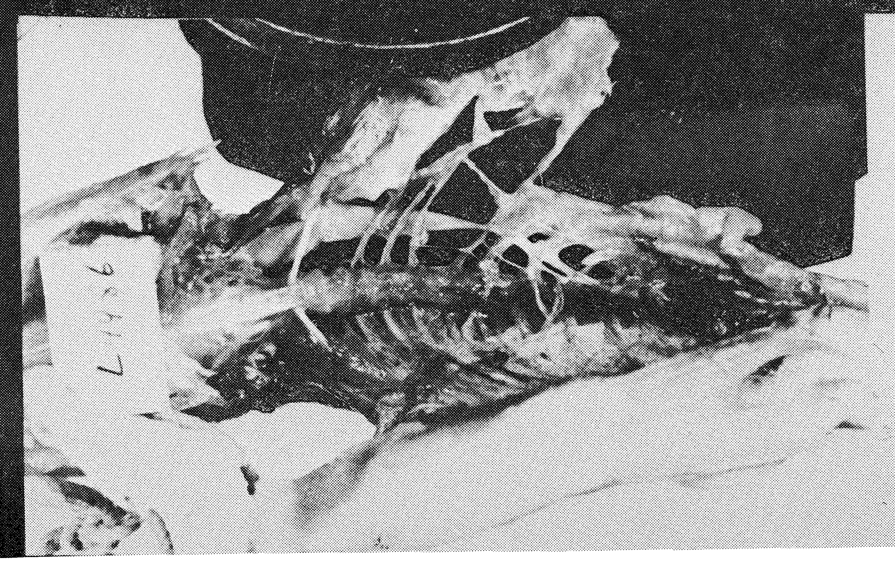

Fig. 2.