J. Northw. Atl. Fish. Sci., Vol. 2: 7-12

Separation of Sharp-beaked Redfish, *Sebastes fasciatus* and *S. mentella*, from Northeastern Grand Bank by Morphology of Extrinsic Gasbladder Musculature

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Abstract

Separation by species of 199 sharp-beaked redfish, collected from northeastern Grand Bank and preliminarily assigned to *Sebastes fasciatus* or *S. mentella* on the basis of some subjective exterior characteristics, was confirmed by differences in the passage of the extrinsic gasbladder muscle between the ventral ribs and in its attachment to the vertebrae posteriorly. In *S. fasciatus* the gasbladder muscle passed between ventral ribs 3–4 in 94% of the specimens and between ribs 4–5 in 5%, whereas in all *S. mentella* the muscle passed between ventral ribs 2–3. Also, the posterior tendon of the gasbladder muscle in *S. fasciatus* commonly had three branches attached primarily to vertebrae 8, 9 and 10, whereas in *S. mentella* the tendons, usually not branched, was attached to vertebra 7.

Introduction

To adequately assess the condition of the redfish stocks in the Northwest Atlantic, the species composition and stock units should be defined according to their distribution, but the classification and nomenclature of *Sebastes* sp. have not yet been clearly defined. Only two species of redfish, *S. mentella* and *S. marinus*, were thought to be distributed in the Northwest Atlantic (Templeman and Sandeman, 1957; Marti, 1958). Recently, however, another species, *S. fasciatus*, has been discussed in the literature (Barsukov, 1968, 1972; Barsukov and Zakharov, 1972; Litvinenko, 1974; Templeman, 1976). *S. fasciatus*, briefly described by Storer (1856) on the basis of only one young specimen, bears a greater resemblance in some features to *S. viviparus* than to either *S. mentella* or *S. marinus*.

Barsukov (1968, 1972) pointed out some morphological differences between *S. fasciatus* and *S. mentella*, and Barsukov and Zakharov (1972) developed a key for the Atlantic species of redfish. However, they admitted that separation of species on the basis of external characteristics alone was very difficult and required considerable skill. Barsukov (1972) said "It is not very simple to distinguish rosefish, *S. fasciatus*, from redfish, *S. mentella*, by their external appearance. Up till now, indeed, it has proven impossible". Litvinenko (1974) found that coloration may serve as a control character in identification of these two different types of sharp-beaked redfish in the juvenile stage. Templeman (1976) noted two different forms of sharp-beaked redfish and called the "American form" *S. fasciatus*, which is distributed at shallower depths than the "Oceanic form" *S. mentella*. However, none of these studies could distinguish these two types of sharp-beaked redfish by a single clear-cut character, because 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 *Sebastes* and found that few species could be separated on the basis of species-specific characteristics of their gasbladder muscles. He also reported that William Eschmeyer had examined a few specimens of North Atlantic redfish and found that the gasbladder muscles passed between ventral ribs 2 and 3 in *S. mentella* and *S. marinus* and between ventral ribs 3 and 4 in *S. fasciatus* and *S. viviparus*.

The purpose of this study was to examine the morphology of extrinsic gasbladder musculature in sharp-beaked redfish from the Newfoundland region with a view to distinguishing between *S. mentella* and *S. fasciatus*.

Materials and Methods

During a cruise of the research vessel *A. T. Cameron* in 1973, 200 specimens of sharp-beaked redfish were collected from northeastern Grand Bank (Table 1). The specimens were preliminarily grouped on the basis of anal fin-ray counts, as suggested by Barsukov and Zakharov (1972), and by depth, as suggested by Templeman (1976). Specimens of samples

TABLE 1. Details of capture of sharp-beaked redfish collected from northeastern Grand Bank on 9-10 September 1973 for morphological studies.

Sample	Species	Position		Depth	Bottom temp.	No. of	Standard length
		Lat.	Long.	(m)	(°C)	fish	(mm)
A.	*S. mentella*	46°40′	47°14′	633	3.4	41	245-377
B.	*S. mentella*	46°38′	47°20′	530	3.4	28	207-373
C.	*S. mentella*	46°36′	47°24′	454	3.3	31	188-314
D.	*S. fasciatus*	46°41′	47°25′	278	2.5	100	160-259

A, B and C, with anal fin-rays numbering 8 or more and taken from deep water, were assigned to the *S. mentella* group. Of 100 specimens in sample D from shallower water, 98 with 7 anal fin-rays were assigned to the *S. fasciatus* group. The remaining 2 specimens with 8 anal fin rays were also assigned to *S. fasciatus* on the basis of other morphological characteristics (head spines, number of pectoral fin rays, etc.). All fish were initially frozen, thawed prior to dissection, and preserved in 10% formalin after dissection. Some of the specimens have been deposited in the National Museum of Natural Sciences, Ottawa, Canada.

Dissection of the gasbladder muscles and tendons was done as described by Hallacher (1974). The pair of gasbladder muscles, one on each side of the midline, appears to originate from the ventral fibers of the epaxialis (the dorsal half of the lateral body musculature) in the occipital region of the cranium and extends posteriorly along the gasbladder ending in the tendons attached to the vertebral parapophyses.

In preliminary dissections, each of the muscle pair was examined with no structural difference being observed. In subsequent dissections, only the muscle on the left side was examined. When the first 9 or 10 ribs were exposed, the dense tissue of the gasbladder muscle was observed to extend laterally just under the ribs. The fish were then examined from the ventral side with the viscera and gasbladder removed, and the muscles were followed to their points of attachment to the vertebral parapophyses (Fig. 1 and 2).

Results

From the dissection of 199 specimens of sharp-beaked redfish (one specimen of the original 200 being damaged), the general appearance of the gasbladder muscle in *S. fasciatus* was similar to that in *S. mentella*. The muscle was long, narrow and uniform in width except for a small ventral projection about midway between the anterior place of origin and point of passage through the ventral ribs. This ventral projection was attached by a tendon to the cleithrum bone of the pectoral girdle. A white ligament (Baudelot's ligament) passed this point of attachment dorsally and extended to the occipital bone. However, particular attention was given to the location of passage of the striated gasbladder muscle between the ventral ribs and to its attachment by one or more tendons to the parapophyses of vertebrae 7-10. No sexual difference or size-related pattern was noted in the characteristics of the extrinsic gasbladder musculature.

Sebastes fasciatus (Fig. 3)

For the 100 specimens examined, the frequency of passage of the gasbladder muscle and associated ligaments through pairs of ventral ribs and their attachment to the parapophyses of one or more vertebrae are given in Table 2A. The main muscle passed between ventral ribs 3-4 in 94 and between ventral ribs 4-5 in 5 of the specimens. In one case, the muscle was bifurcated and the branches passed between ventral ribs 3-4 and 4-5. About half of the specimens had one or more small muscles or ligaments, associated with the gasbladder muscle, passing between the ventral ribs. These small muscles or ligaments in 38 specimens passed between ribs 2-3, 8 between ribs 3-4, 7 between ribs 4-5 and 1 between ribs 5-6.

Large variation was found in the number of insertion points of tendons on vertebrae, the numbers of fish (in parentheses) having one to four branches from the main tendon being as follows: 1(6), 2(42), 3(49) and 4(2). In addition, the attachments of one or two branches from minor tendons were observed in 40 specimens. The numbers of fish (in parentheses), which had branches of major tendons attached to vertebrae 6-12, are as follows: 6(1), 7(12), 8(55), 9(89), 10(83), 11(3), and 12(1). Although branches of minor tendons were found to be attached to vertebrae 5-10 in the 40 specimens with such tendons, the larger numbers of attachments were to vertebrae 7(17) and 8(14).

Sebastes mentella (Fig. 4)

For the 99 specimens examined, the frequency of passage of the gasbladder muscle and associated ligaments through pairs of ventral ribs and their attachment of one or more vertebrae are given in Table 2B. The main muscle passed between ventral ribs 2-3 in 93 specimens, and was bifurcated in 6 specimens, one

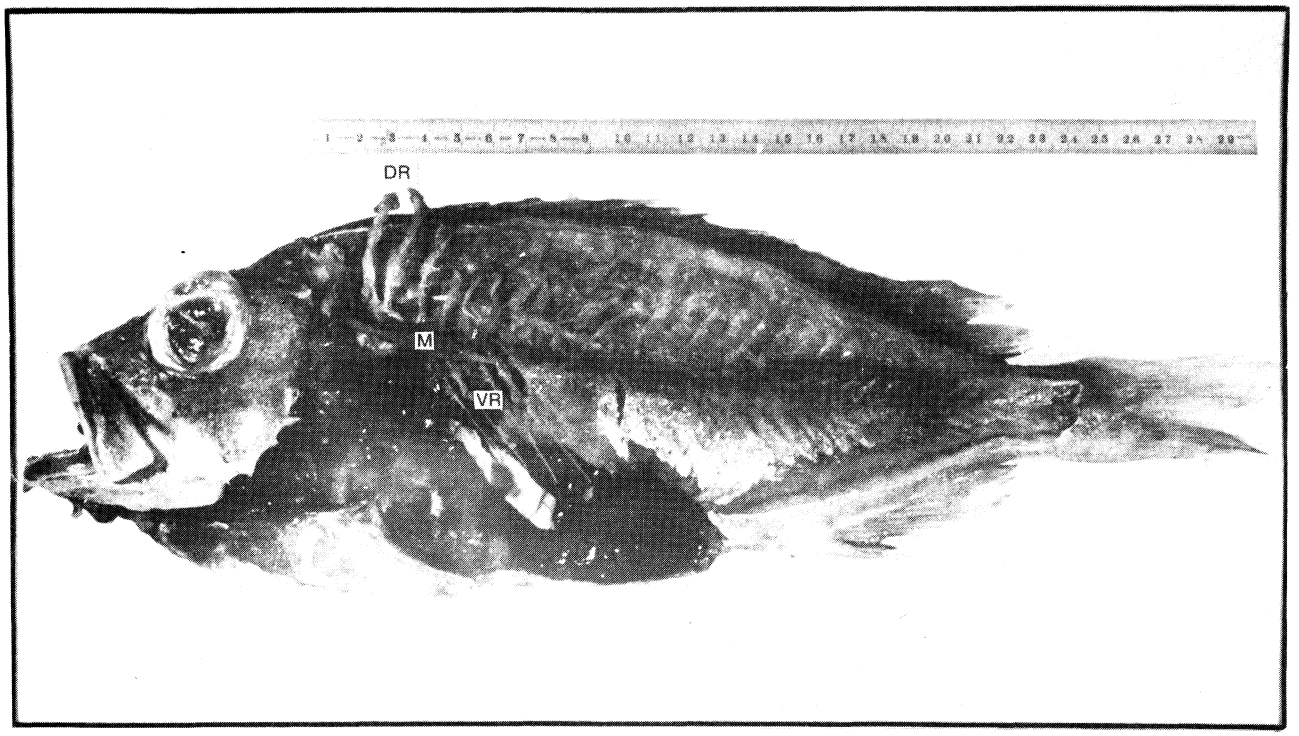

Fig. 1. Exposed left extrinsic gasbladder muscle of a sharp-beaked redfish, with focus on the route of the muscle between ventral ribs. (M = striated gasbladder muscle; DR = dorsal ribs; VR = ventral ribs.).

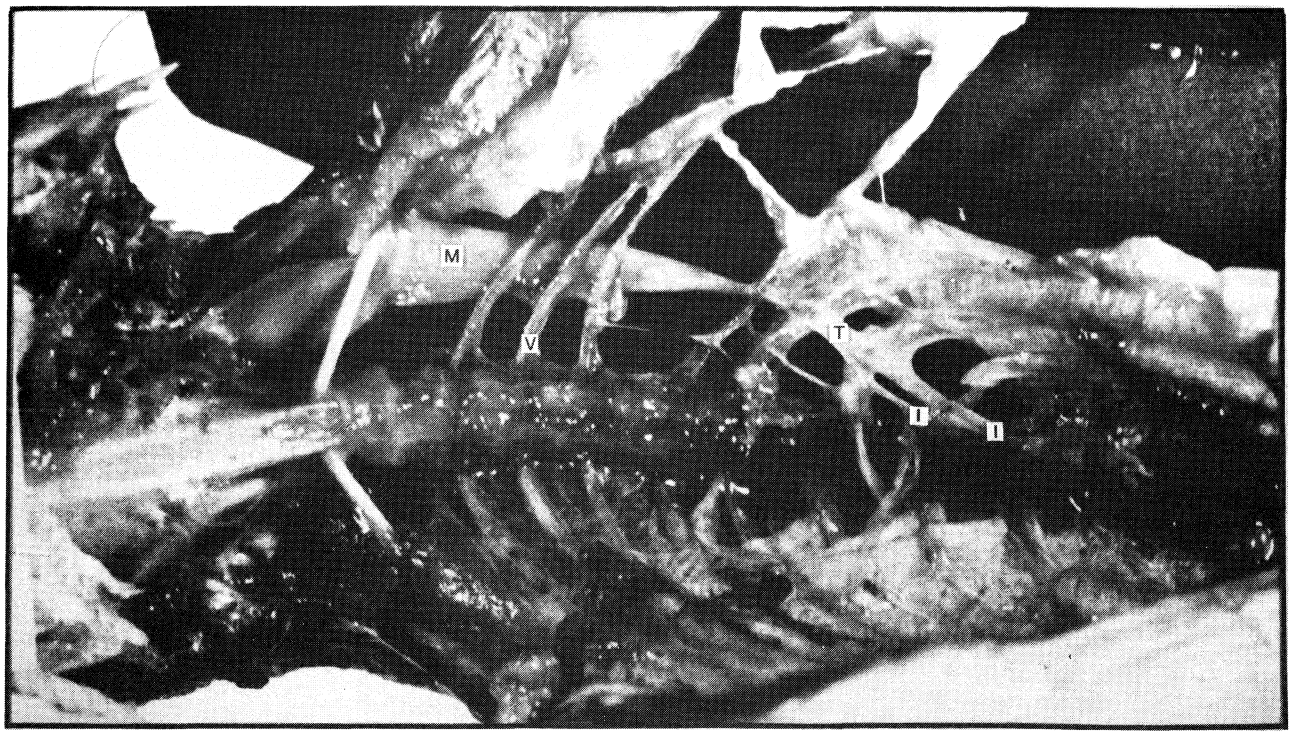

Fig. 2. Ventral view of gasbladder muscle of a sharp-beaked redfish showing route between ventral ribs and points of insertion on the paraphyses of vertebrae. (M = striated gasbladder muscle; T = gasbladder muscle tendon; V = ventral ribs; I = insertion of tendons to the parapophyses of vertebrae.)

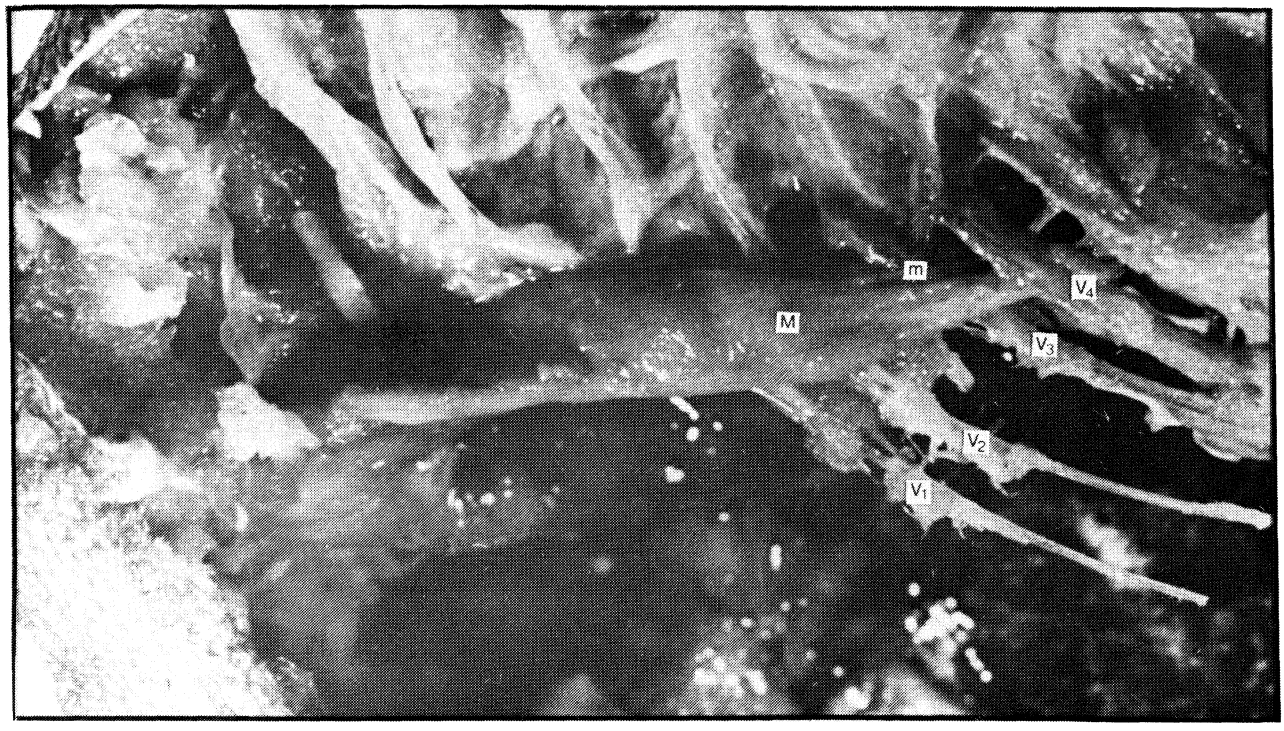

Fig. 3. Extrinsic gasbladder muscle of *S. fasciatus* passing between ventral ribs 3 and 4. (M = gasbladder muscle; m = minor muscle or ligament; V = ventral ribs.)

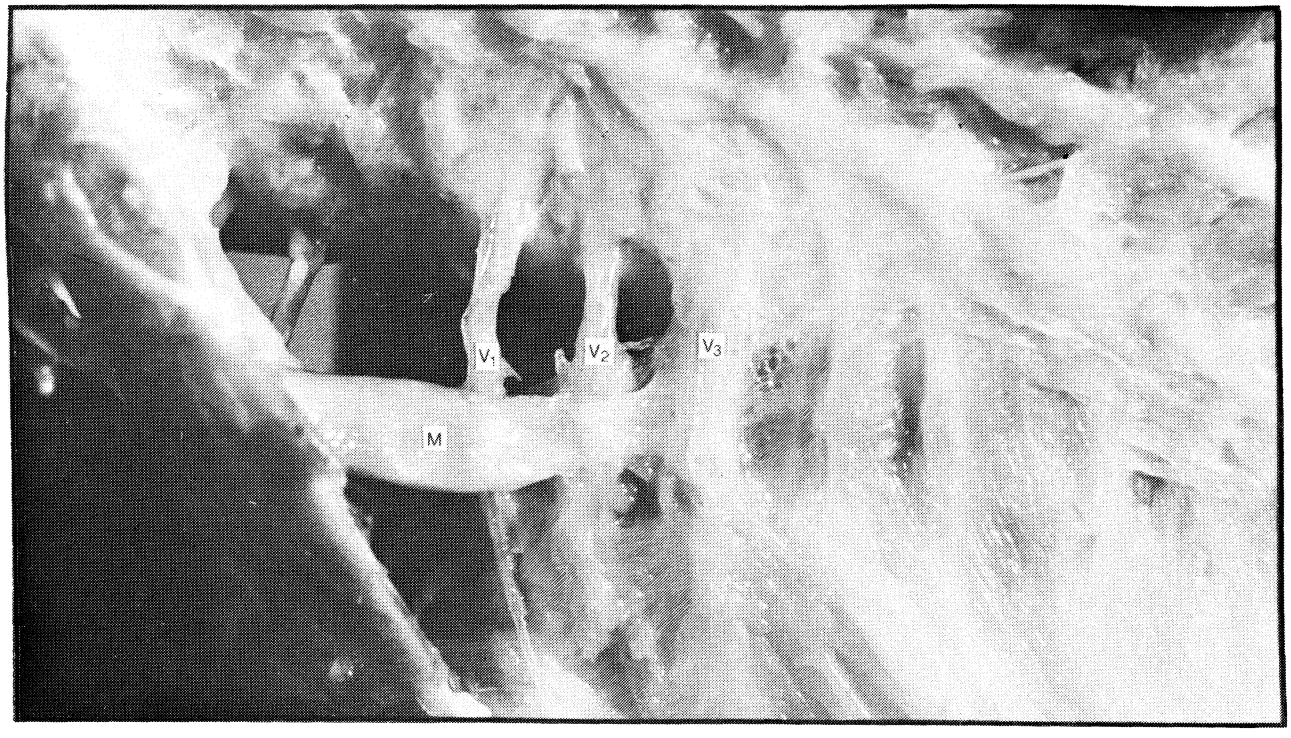

Fig. 4. Extrinsic gasbladder muscle of *S. mentella* passing through ventral ribs 2 and 3. (M = gasbladder muscle; V = ventral ribs.)

TABLE 2. Frequencies of the passage of the gasbladder muscle between the ventral ribs and its attachment to parapophyses of vertebrae in (A) *S. fasciatus* and (B) *S. mentella*. (M's refer to the main muscles and m's to minor muscles or ligaments; T's refer to tendon branches from the main muscle and t's refer to minor tendons. The numbers in the last row of A and B are frequencies of occurrence of M's and T's.

Ventral ribs between which the muscles pass					Vertebrae to which the tendon branches attached									
1-2	2-3	3-4	4-5	5-6	4	5	6	7	8	9	10	11	12	Frequency
A. *Sebastes fasciatus*														
		M							T	T	T			20
		.M								T	T			19
		M						T	T	T				3
		M						T	T	T	T			1
		M					T	T	T					1
		M									T	T	T	1
		M							T	T				1
		M							T		T			1
		M									T			1
	m	M							t	T	T			9
	m	M					t	T	T	T				5
	m	M						t	T	T	T			5
	m	M							T	T	T			4
	m	M						t		T	T			3
	m	M								t	T			2
	m	M				t		T	T	T				1
	m	M					t			T	T	T		1
	m	M							T	Tt	T			1
	m	M						t	T	T				1
	m	M						t	T		T			1
	m	M						t			T			1
		Mm							T	T	T			2
		Mm							TT	T	T			1
	mm	M						t	t	T	T			1
	m	M	m					T	T	T				1
	m	M	m				t		T	T	T			1
		M	m						T	T	T			1
		M	m						t	T	T			2
		M	m					t	T	T	T			2
			M							T	T			1
		m	M					t	T	T				1
		m	M								T	T		1
		mm	M						T	t	t			1
		Mmm	M					t	t	T	T			1
	m	m	M	m				t	t	T				1
		M							(damaged)					1
	—	95	6	—		—	1	12	55	89	83	3	1	100
B. *Sebastes mentella*														
	M							T						50
	M							T	T					16
	M						T	T						6
	M							TT						5
	M								T					3
	M						T	T	T					3
	M						T		T					1
	M				T		T							1
	M								TT					1
M	M						T	T						1
m	M						t	T						1
m	M							Tt						1
	mM							T						2
	mM				t			T						1
	mM						T	T						1
	M	M						TT						1
	M	M						T	T					2
	mM	M					t	T	T					1
	mM	M					t		T	T				1
	M						(damaged)							1
1	99	5			1	—	13	91	28	1				99

with branches passing between ventral ribs 1-2 and 2-3, and 5 with branches passing between ribs 2-3 and 3-4. Only 8 specimens had minor muscles or ligaments, which passed between ventral ribs 2-3 in 6 fish and between ribs 1-2 in 2 fish.

The numbers of fish having one to three branches of major tendons attached to vertebrae were 58, 37 and 3 respectively. In addition, the attachment of a single minor tendon was observed in 5 specimens. The numbers of fish (in parentheses) which had major tendons attached to vertebrae 4-9 are as follows: 4(1), 5(0), 6(13), 7(91), 8(28), and 9(1). Single attachments of minor tendons were observed in only 5 specimens, three to vertebrae 6 and one to vertebrae 5 and 7.

Discussion

In the 199 redfish specimens, which were initially assigned to *S. fasciatus* and *S. mentella* on the basis of a variety of rather subjective external characteristics, the paths of the extrinsic gasbladder muscles between the ventral ribs and their attachment posteriorly to vertebrae were clearly different in the two species. In *S. fasciatus* most of the gasbladder muscles passed between ventral ribs 3-4, whereas in *S. mentella* the muscles passed between ventral ribs 2-3. In *S. fasciatus* the posterior end of the gasbladder muscle was attached to the parapophyses of the vertebrae most frequently by 3 or 2 branches of the main tendon, whereas in *S. mentella* the attachment was commonly by one but sometimes by 2 branches of the main tendon. The attachment of the main tendon branches was mainly to vertebrae 8, 9 and 10 in *S. fasciatus* but to vertebra 7 in *S. mentella*.

The two specimens of sample D, with 8 anal fin rays and preliminarily assigned to *S. fasciatus*, were both similar to the other *S. fasciatus* specimens, in that each had a large gasbladder muscle passing between ventral ribs 3-4. Also, one had 3 main tendon branches to vertebrae 9, 10 and 11, and the other had 3 branches to vertebrae 8, 9 and 10.

A preliminary study of 9 *S. marinus* specimens indicated that the extrinsic gasbladder muscle was short, wide and bifurcated, and that the branches passed between ventral ribs 2-3 and 3-4. However, this finding must be verified by further dissections because it differs from that of Eschmeyer (Hallacher, 1974). Further examination of the 7 sharp-beaked redfish with bifurcated muscles (one assigned to *S. fasciatus* and 6 to *S. mentella*) produced no evidence to indicate that they were *S. marinus*, as they all had large eyes and a pointed symphysial tubercle on the lower jaw.

Barsukov and Zakharov (1972) suggested that *S. fasciatus* differed from *S. mentella* and *S. marinus* in morphological features and distribution as well as in size at maturity and spawning period. In their opinion, these are closely related species and not intraspecific categories of the same species.

This study provides further evidence on the existence of two species of sharp-beaked redfish in the Newfoundland area, and the difference in the path of the gasbladder muscles between the ventral ribs appears to be a good discriminator between the two species.

Acknowledgements

Mr L. S. Parsons and Mr E. LeGrow provided access to unpublished data. Dr W. D. McKone and Mrs. C. Gavaris offered suggestions and help. All of this assistance I gratefully acknowledge.

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