MORPHOMETRIC CHARACTERS OF TWO MORONE HYBRIDS

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Abstract: Morphometric ratios of female striped bass (*Morone saxatilis*) X male white bass (*M. chrysops*) and female striped bass X male white perch (*M. americana*) that were best for distinguishing them from the parental species were: standard length/body depth, head length/second anal spine length, head length/fourth dorsal spine length, standard length/fork length, fork length/total length, second anal spine length/third anal spine length and head length/upper jaw length. Ratios were generally intermediate between those of the parental species, but sometimes differed from those of either parent. Computer plots of ratios against standard length demonstrated that many changed as a function of fish length; thus care should be taken to utilize similar sized individuals when employing them for identification purposes. Plots of body measurements against standard length indicated most were linear, with the general exception of head depth, fourth dorsal spine length and the 3 anal spine lengths.

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Striped bass hybrids were first produced by Robert E. Stevens in 1965, when female striped bass were crossed with male white bass at the South Carolina striped bass hatchery (Bayless 1968, Bishop 1968). Since then, they have been artificially propagated and widely stocked in fresh-water impoundments in the southeastern and southwestern United States as a management tool and for a food and sport fish (Ware 1975, Stevens 1975). Williams (1976) reported that introduction of these hybrids into many reservoirs has resulted in confusion among fishermen, enforcement officers and, in some instances, biologists, with regard to species identification, and that a positive means of separating them was a pressing need.

Female striped bass X male white perch were first produced in North Carolina in 1966 (Smith, Bonner and Tatum 1967), but little work has been done with them outside of experimental laboratory studies (Kerby 1972, Kerby and Joseph 1979).

General descriptions of both hybrid types, as well as rather detailed meristic counts, have been published (Bayless 1968, 1972, Kerby et al. 1971, Williams 1976, and Kerby 1979), but relatively little work, other than that of Bayless (1972) and Williams (1976), has been done on the morphometrics of either hybrid.

This paper presents and compares morphometrics of the 2 types of hybrid. Criteria for separating them from each other and from the parental species are established. Throughout the paper, SB X WB is used to denote striped bass X white bass and SB X WP is used to denote striped bass X white perch.

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MATERIALS AND METHODS

Morphometric data were collected from 100 specimens of each hybrid. The SB X WB hybrids were obtained from the Rappahannock River, Virginia (Kerby et al. 1971). They were Age I or II and ranged in standard length from 190 to 376 mm ($\bar{x}$ = 251.4). The SB X WP hybrids were reared in the laboratory from crosses obtained in 1969 and 1970 at the South Carolina striped bass hatchery. They were Age 0 or I and ranged in standard length from 88 to 299 mm ($\bar{x}$ = 175.3 mm). The white perch parents originated in the Rappahannock River, Virginia, whereas the striped bass parents originated in the Cooper River, South Carolina.

Standard and fork lengths were taken from freshly caught SB X WB specimens and each fish was tagged with an identification number. Fifty-four fish were preserved in 10% buffered formalin, whereas 46 were frozen. After about 2 years, they were remeasured and additional measurements were made. Analysis of variance was used to determine if differences in preservation procedures (i.e., freezing vs formalin) resulted in significant differences between standard and fork lengths of fish in the fresh condition and the same fish after preservation.

The following morphometric characters were measured according to Hubbs and Lagler (1958): Total length, fork length, standard length, caudal peduncle length, caudal peduncle depth, predorsal length, head length, head depth, snout length, eye length, upper jaw length, and mandible length. Measurements of body depth (origin of the first dorsal fin to origin of the pelvic fin) and prepelvic distance (anterior base of the pelvic fin to tip of lower jaw) were made according to Lund (1957). Maximum lengths of the longest dorsal spine and of each of the 3 anal apines were measured after separation from the interneurals and interhaemals by dissection. Total length, fork length, and standard length were measured to the nearest millimeter on a measuring board. All other measurements were made to the nearest 0.1 mm using dial calipers.

RESULTS AND DISCUSSION

Standard and fork lengths of freshly caught SB X WB hybrids were not significantly different from those of the same specimens after freezing (standard length, $F = 1.93$, $dF = 1, 86$; fork length, $F = 0.91$, $dF = 1,86$) or after preservation in formalin (standard length, $F = 0.17$, $dF = 1, 108$; fork length, $F = 0.11$; $dF = 1, 108$). Therefore, data for all specimens were lumped for morphometric analysis.

Ratios of body measurements for both types of hybrid were computed for each 10-mm standard length increment (Kerby 1972). Computer plots of the ratios against standard length demonstrated that many of the ratios changed (the values either increasing or decreasing) as a function of body length. If ratios used for identification purposes change significantly as a function of fish length, only ratios for similar size groups can be compared.

Certain characters produced ratios that were particularly likely to change with changes in fish length (Tables 1 and 2). These included most SB X WB ratios involving the fourth dorsal spine length, eye length, and first, second and third anal spine lengths. In general, the only ratios in which these characters were used that did not change as a function of fish size were those in which they were divided by each other.

SB X WP ratios were most likely to change as a function of fish length if they included eye length, second and third anal spine lengths, body depth, fourth dorsal spine length, or upper jaw length (Table 2). Every ratio involving eye length changed with increasing fish length, as did all ratios involving second anal spine length, except for those combining it

TABLE 1. Mean morphometric ratios for 100 striped bass X white bass hybrids. Each ratio consists of the character specified in the column heading divided by the character specified in the left column. An asterisk after a value indicates that the ratio changed as a function of standard length. Standard length ranged from 190 to 376 mm. Ranges of underlined values did not overlap ranges of similar values for striped bass X white perch hybrids.

a) Ratios for measurements 1-9.

Character	Total Length	Fork Length	Standard Length	Body Depth	Caudal Peduncle Depth	Caudal Peduncle Length	Predorsal Length	Fourth Dorsal Spine Length	Head Length
Total Length	1.00	0.93	0.79	0.25	0.10	0.16	0.32	0.14*	0.25*
Fork Length	1.08	1.00	0.85*	0.27	0.10	0.17	0.34	0.15*	0.27*
Standard Length	1.26	1.17*	1.00	0.32	0.12	0.20	0.40	0.17*	0.32*
Body Depth	4.01	3.72	3.18	1.00	0.39*	0.63	1.27*	0.55*	1.00*
Caudal Peduncle Depth	10.35	9.60	8.20	2.58*	1.00	1.61	3.26	1.41*	2.59
Caudal Peduncle Length	6.42	5.95	5.08	1.60	0.62	1.00	2.02	0.87*	1.60
Predorsal Length	3.17	2.94	2.51	0.79*	0.31	0.49	1.00	0.43*	0.79
Fourth Dorsal Spine Length	7.36*	6.83*	5.83*	1.83*	0.71*	1.15*	2.32*	1.00	1.84*
Head Length	4.00*	3.71*	3.17*	1.00*	0.39	0.62	1.26	0.54*	1.00
Head Depth	6.31	5.86*	5.00*	1.57*	0.61	0.98	1.99	0.86*	1.58
Snout Length	16.12	14.96	12.76	4.02	1.56	2.51	5.08	2.19*	4.03*
Eye Length	23.87*	22.15*	18.91*	5.95*	2.31*	3.72*	7.53*	3.24*	5.97*
Upper Jaw Length	10.21	9.48	8.09*	2.54*	0.99	1.59	3.22	1.39*	2.55
Mandible Length	7.70	7.14*	6.10*	1.92*	0.74	1.20	2.43	1.05*	1.92
Prepelvic Distance	3.26	3.02	2.58	0.81	0.32	0.51	1.03	0.44*	0.81
1st Anal Spine Length	27.52*	25.54*	21.80*	6.86*	2.66*	4.29*	8.68*	3.74	6.88*
2nd Anal Spine Length	13.50*	12.52*	10.69*	3.36*	1.30*	2.10*	4.26*	1.84	3.37*
3rd Anal Spine Length	11.39*	10.57*	9.02*	2.84*	1.10*	1.77*	3.60*	1.55	2.85*

b) Ratios for measurements 10-18.

Character	Head Depth	Snout Length	Eye Length	Upper Jaw Length	Mandible Length	Pre-pelvic Distance	1st Anal Spine Length	2nd Anal Spine Length	3rd Anal Spine Length
Total Length	0.16	0.06*	0.04*	0.10	0.13	0.31	0.04*	0.07*	0.09*
Fork Length	0.17*	0.07*	0.04*	0.11	0.14*	0.33	0.04*	0.08*	0.10*
Standard Length	0.20*	0.08	0.05*	0.12*	0.16*	0.39	0.05*	0.09*	0.11*
Body Depth	0.64*	0.25	0.17*	0.39*	0.52*	1.23	0.15*	0.30*	0.35*
Caudal Peduncle Depth	1.64	0.64	0.43*	1.01	1.34	3.18	0.38*	0.77*	0.91*
Caudal Peduncle Length	1.02	0.40	0.27*	0.63	0.83	1.97	0.23*	0.48*	0.56*
Predorsal Length	0.50	0.20	0.13*	0.31	0.41	0.97	0.12*	0.24*	0.28*
Fourth Dorsal Spine Length	1.17*	0.46*	0.31*	0.72*	0.96*	2.26*	0.27	0.54	0.64
Head Length	0.63	0.25*	0.17*	0.39	0.52	1.23	0.14*	0.30*	0.35*
Head Depth	1.00	0.39*	0.26*	0.62	0.82	1.94	0.23*	0.47*	0.55*
Snout Length	2.56*	1.00	0.68*	1.58*	2.09*	4.95	0.59*	1.20*	1.42*
Eye Length	3.78*	1.48*	1.00	2.34*	3.10*	7.33*	0.87	1.77	2.10
Upper Jaw Length	1.62	0.63*	0.43*	1.00	1.33	3.13	0.37*	0.76*	0.90*
Mandible Length	1.22	0.48*	0.32*	0.75	1.00	2.36	0.28*	0.57*	0.68*
Prepelvic Distance	0.52	0.20	0.14*	0.32	0.42	1.00	0.12*	0.24*	0.29*
1st Anal Spine Length	4.36*	1.71*	1.15	2.70*	3.58*	8.45*	1.00	2.05	2.42
2nd Anal Spine Length	2.14*	0.84*	0.56	1.32*	1.75*	4.14*	0.49	1.00	1.18
3rd Anal Spine Length	1.81*	0.71*	0.48	1.12*	1.48*	3.50*	0.41	0.84	1.00

TABLE 2. Mean morphometric ratios for 100 striped bass X white perch hybrids. Each ratio consists of the character specified in the column heading divided by the character specified in the left column. An asterisk after a value indicates that the ratio changed as a function of standard length. Standard length ranged from 88 to 299 mm. Ranges of underlined values did not overlap ranges of similar values for striped bass X white bass hybrids.

a) Ratios for morphometric measurements 1-9.

Character	Total Length	Fork Length	Standard Length	Body Depth	Caudal Peduncle Depth	Caudal Peduncle Length	Predorsal Length	Fourth Dorsal Spine Length	Head Length
Total Length	1.00	0.95	0.83	0.25*	0.09	0.16	0.34	0.13*	0.29
Fork Length	1.05	1.00	0.87	0.27*	0.10	0.17	0.36*	0.14*	0.30
Standard Length	1.21	1.15	1.00	0.31	0.11	0.20	0.41*	0.16*	0.35
Body Depth	3.95*	3.76*	3.26	1.00	0.36*	0.65	1.35*	0.51*	1.14*
Caudal Peduncle Depth	10.85	10.34	8.97	2.75*	1.00	1.78	3.71	1.39*	3.14
Caudal Peduncle Length	6.11	5.82	5.05	1.55	0.56	1.00	2.09	0.78*	1.77
Predorsal Length	2.93	2.79*	2.42*	0.74*	0.27	0.48	1.00	0.38	0.85
Fourth Dorsal Spine Length	7.78*	7.42*	6.43*	1.97*	0.72*	1.27*	2.66	1.00	2.26
Head Length	3.45	3.29	2.85	0.87*	0.32	0.56	1.18	0.44	1.00
Head Depth	5.89	5.61	4.87	1.49	0.54	0.96	2.01	0.76*	1.71*
Snout Length	13.54	12.90	11.19	3.43	1.25	2.22	4.62	1.74	3.92
Eye Length	18.76*	17.89*	15.50*	4.75*	1.73*	3.07*	6.41*	2.41*	5.44*
Upper Jaw Length	9.86*	9.39*	8.15*	2.50*	0.91	1.61*	3.37	1.27	2.86
Mandible Length	7.50	7.14	6.20	1.90	0.69	1.23	2.56	0.96	2.17
Prepelvic Distance	3.14	3.00	2.60	0.80	0.29	0.51	1.07	0.40*	0.91
1st Anal Spine Length	28.73	27.37*	23.74*	7.28*	2.65*	4.70*	9.81	3.69	8.33
2nd Anal Spine Length	12.05*	11.48*	9.96*	3.05*	1.11*	1.97*	4.12*	1.55	3.49*
3rd Anal Spine Length	10.46*	9.96*	8.65*	2.65*	0.96	1.71*	3.57*	1.34	3.03*

b) Ratios for measurements 10-18.

Character	Head Depth	Snout Length	Eye Length	Upper Jaw Length	Mandible Length	Pre-pelvic Distance	1st Anal Spine Length	2nd Anal Spine Length	3rd Anal Spine Length
Total Length	0.17	0.07	0.05*	0.10*	0.13	0.32	0.04	0.08*	0.10*
Fork Length	0.18	0.08	0.06*	0.11*	0.14	0.33	0.04*	0.09*	0.10*
Standard Length	0.20	0.09	0.06*	0.12*	0.16	0.38	0.04*	0.10*	0.12*
Body Depth	0.67	0.29	0.21*	0.40*	0.53	1.26	0.14*	0.33*	0.38*
Caudal Peduncle Depth	1.84	0.80	0.58*	1.10	1.45	3.45	0.38*	0.90*	0.14
Caudal Peduncle Length	1.04	0.45	0.33*	0.62*	0.82	1.94	0.21*	0.51*	0.58*
Predorsal Length	0.50	0.22	0.16*	0.30	0.39	0.93	0.10	0.24*	0.28*
Fourth Dorsal Spine Length	1.32*	0.58	0.42*	0.79	1.04	2.48*	0.27	0.65	0.74
Head Length	0.59*	0.26	0.18*	0.35	0.46	1.10	0.12	0.29*	0.33*
Head Depth	1.00	0.44	0.31*	0.60*	0.79	1.87	0.20	0.49*	0.56*
Snout Length	2.30	1.00	0.72*	1.37	1.81	4.31	0.47	1.12*	1.30
Eye Length	3.18*	1.38*	1.00	1.90*	2.50*	5.97*	0.65*	1.56*	1.79*
Upper Jaw Length	1.67*	0.73	0.53*	1.00	1.32	3.14*	0.34	0.82*	0.94
Mandible Length	1.27	0.55	0.40*	0.76	1.00	2.38	0.26	0.62*	0.72
Prepelvic Distance	0.53	0.23	0.17*	0.32*	0.42	1.00	0.11	0.26*	0.30*
1st Anal Spine Length	4.88	2.12	1.53*	2.91	3.83	9.14	1.00	2.38	2.75
2nd Anal Spine Length	2.05*	0.89*	0.64*	1.22*	1.61*	3.83*	0.42	1.00	1.15*
3rd Anal Spine Length	1.78*	0.77	0.56*	1.06	1.40	3.33*	0.36	0.87*	1.00

with the fourth dorsal spine length or the first anal spine length. At least 50% of the ratios involving the other 4 characters also changed as a function of fish length.

Examination of ratios from the parental species (obtained from the literature) indicate that a few are sufficiently well-documented to be useful in distinguishing them from the hybrids (Table 3) because there was little or no overlap with the hybrid ratios. The SB X WB hybrids appear to be best distinguished from striped bass by comparing the following ratios: standard length/body depth (SL/BD), head length/second anal spine length (HL/2ASL), and head length/fourth dorsal spine length (HL/4DSL); and from white bass: SL/BD, standard length/fork length (SL/FL), fork length/total length (FL/TL), and second anal spine length/third anal spine length (2ASL/3ASL). Likewise, the SB X WP hybrids can best be differentiated from striped bass by comparing SL/BD, HL/2ASL, and head length/upper jaw length (HL/UJL).

Williams (1976) suggested that 2 additional ratios, fork length/body depth (FL/BD) and body depth/head length (BD/HL) offered positive means of distinguishing SB X WB hybrids from striped bass because no overlap occurred in the values. The former appears to be an excellent characteristic if values reported by Bayless (1972), which are generally lower than other reported values, are not considered (Table 3). The second ratio (BD/HL) was considered a good character for the same reason. However, SB X WB values ranged from 0.93 to 1.09 in the present study and overlap slightly with striped bass values reported by Williams (1976). This descrepancy may be the result of the generally larger fish used by Williams since my data indicate that this ratio increases with increasing fish length.

Some of the other values suggested herein as being good distinguishing characters also change as a function of fish length (Tables 1 and 2) so care should be used when employing them. Further measurements should be taken on the parental species to provide more definitive comparisons.

TABLE 3. Comparisons of striped bass X white bass and striped bass X white perch hybrid ratios with those of the parental species. Single numbers represent either means or approximations. Numbers in parentheses represent the range.

Species	Standard Length Divided by Body Depth	Standard Length Divided by Head Length	Standard Length Divided by Head Depth	Standard Length Divided by Caudal Peduncle Depth	Standard Length Divided by Predorsal Length	Standard Length Divided by Prepelvic Distance	Standard Length Divided by Upper Jaw Length	Standard Length Divided by Total Length	Standard Length Divided by Fork Length	Source
Striped Bass	(3.5-4)	(3.25-3.5)								Jordan and Evermann 1896
	(3.45-4.2)	(3.1-3.25)								Hildebrand and Schroeder 1928
	3.7	3.1		9.6						Merriman 1941
	(3.45-4.2)	(2.9-3.25)								
	3.2									Bishop 1968
	(3.49-3.62)	(2.97-3.21)		(9.06-9.27)	(2.46-2.53)	(2.52-2.69)				Barkuloo 1970[1]
White Bass	2.5	3.5								Jordan and Evermann 1896
								0.77	0.90	Sigler 1949
	2.4									Bishop 1968
Striped Bass	2.7									Bishop 1968
X White Bass	3.18	3.17	5.00	8.20	2.51	2.58	8.09	0.79	0.85	Present Study
	(2.97-3.35)	(3.09-3.28)	(4.87-5.24)	(8.09-8.48)	(2.49-2.57)	(2.51-2.62)	(7.93-8.35)	(0.78-0.80)	(0.85-0.86)	
Striped Bass	3.26	2.85	4.87	8.97	2.42	2.60	8.15	0.83	0.87	Present Study
X White Perch	(3.10-3.42)	(2.78-3.00)	(4.64-5.11)	(8.43-9.39)	(2.36-2.52)	(2.49-2.67)	(7.86-8.68)	(0.81-0.85)	(0.86-0.88)	
White Perch	(2.5-3)	(2.75-3)								Jordan and Evermann 1896
	(2.6-3.2)	(2.6-2.95)								Hildebrand and Schroeder 1928
								(0.80-0.82)		Mansueti 1961
	2.71	2.87	3.86	7.67	2.21		8.00			Woolcott 1962[2]
	(2.4-3.6)	(2.6-3.3)	(3.3-5.00)	(6.3-10.0)	(2.0-2.6)		(6.7-11.1)			

Table 3. (Cont.)

Species	Fork Length Divided by Total Length	Fork Length Divided by Body Depth	Head Length Divided by Upper Jaw Length	Head Length Divided by Eye Length	Head Length Divided by Snout Length	Head Length Divided by 4th Dorsal Spine Length	Head Length Divided by 2nd Anal Spine Length	Eye Length Divided by Snout Length	2nd Anal Spine Length Divided by 3rd Anal Spine Length	Source
Striped Bass			2.8	(5-7)		2.3	(5-6)	(0.5-0.67)		Jordan and Evermann 1896
			(2.4-2.7)	(3.3-4.15)						Hildebrand and Schroeder 1928
				(3-4.9)		2.2				Merriman 1941
		3.9					4.54		0.74	Bayless 1972
		(3.7-4.2)					(4.4-5.2)		(0.73-0.83) [1]	
		4.44								Williams 1976
		(4.02-5.32)								
White Bass			2.75	6	4.33	2	3			Jordan and Evermann 1896
	0.86									Sigler 1949
			(2.2-2.7)							Trautman 1957
		2.6					2.9		0.72	Bayless 1972
		(2.4-2.8)					(2.4-3.1)		(0.68-0.75)	
Striped Bass		2.7					4.01		0.92	Bayless 1972
X White Bass		(2.6-3.4)					(3.4-4.03)		(0.89-0.96)	
		3.47								Williams 1976
		(3.08-3.99)								
	0.93	3.72	2.55	5.97	4.03	1.84	3.37	0.68	0.84	Present Study
	(0.92-0.93)	(3.47-3.90)	(2.52-2.60)	(5.30-7.01)	(3.81-4.21)	(1.73-2.04)	(2.97-3.86)	(0.54-0.80)	(0.82-0.90)	
Striped Bass		3.9								Bayless 1972
X White Perch		(3.8-4.2)					(3.4-3.8)		(0.81-1.0)	
	0.95	3.76	2.86	5.44	3.92	2.26	3.49	0.72	0.87	Present Study
	(0.94-0.96)	(3.59-3.98)	(2.77-2.98)	(4.14-6.60)	(3.82-4.06)	(1.92-2.68)	(2.79-3.96)	(0.59-0.97)	(0.78-0.98)	
White Perch			2.8	4		2	(2.6-3)			Jordan and Evermann 1896
			(2.65-3.1)	(3.2-4.85)	(3.6-4.2)					Hildebrand and Schroeder 1928
			(2.7-3.5)							Trautman 1957

[1] Reciprocals of original data are given to conform with other table values.

[2] Means pertain to white perch from the Rappahannock River, Virginia. Ranges include samples from all areas studied.

Comparisons of the ratios for each hybrid type indicate that many are similar, with overlapping values, whereas others are different. Morphological characters most likely to produce ratios with no overlap between the hybrid types were head length, snout length and total length (Tables 1 and 2). Some of the ratios (and their reciprocals) that appear to be better distinguishing characters for the hybrids include: head length/total length (HL/TL), caudal peduncle length/snout length (CPL/SNL), fourth dorsal spine length/eye length (4DSL/EL), head length/prepelvic distance (HL/PPD), head length/caudal peduncle depth (HL/CPD), fourth dorsal spine length/3rd anal spine length (4DSL/3ASL), HL/UJL, and head length/head depth (HL/HD).

Most computer plots of body measurements against standard length indicated linear relationships, although plots of head depth, fourth dorsal spine length, and the three anal spine lengths against standard length for the SB X WP hybrids appeared to be slightly curvilinear. Linear regressions were calculated with standard length as the independent variable (Table 4) for all of these relationships, including those which were slightly curvilinear, because various other methods of data transformation did not appear to improve the prediction value of the equations. Predictions of various body measurements using the regressions are good (as determined from tables of residuals), except for anal spine lengths.

The most pronounced deviations from linear relationships occurred in SB X WB plots of the three anal spine lengths against standard length. From the plots it appeared that a change in growth rate of these spines (and perhaps head depth and fourth dorsal spine length as well) occurred, in which spine growth slowed in relation to growth in standard length. Unfortunately, because of considerable variation in spine length and because no fish between 271 and 330 mm standard length were collected, the changes could not be adequately documented and may not be real. However, the changes in growth rate suggested by the slightly curvilinear SB X WP plots of standard length against first and second anal spine lengths is probably real, and may become more pronounced in larger fish.

TABLE 4. Statistics for regressions of body measurements on standard length for striped bass X white bass and striped bass X white perch hybrids. Regressions are linear, in the form $Y = a + bX$, where a is the Y-intercept and b is the slope of the regression line. The independent variable (X) is always standard length; r is the coefficient of correlation.

Dependent Variable (Y)	Striped Bass X White Bass (SL range = 190-376 mm, mean SL = 252 mm)			Striped Bass X White Perch (SL range = 88-229 mm, mean SL = 174 mm)		
	a	b	r	a	b	r
Total Length	9.357	1.225*	0.998	4.459	1.184	0.999
Fork Length	6.310	1.147*	0.998	2.709	1.141	0.999
Body Depth	-7.397	0.344*	0.977	-2.228	0.319	0.996
Caudal Peduncle Depth	1.288	0.117*	0.982	0.786	0.107	0.994
Caudal Peduncle Length	2.253	0.188	0.975	-0.195	0.199*	0.994
Predorsal Length	3.977	0.382	0.991	2.794	0.397*	0.997
Fourth Dorsal Spine Length	13.865	0.116	0.927	3.541	0.135*	0.971
Head Length	6.726	0.289	0.992	2.200	0.338*	0.996
Head Depth	4.898	0.181	0.964	-0.011	0.206*	0.993
Snout Length	-1.109	0.083	0.984	0.487	0.087*	0.992
Eye Length	6.949	0.025	0.929	4.490	0.039*	0.968
Upper Jaw Length	2.418	0.114*	0.990	1.707	0.113	0.994
Mandible Length	3.650	0.149	0.989	-0.055	0.162*	0.986
Prepelvic Distance	2.728	0.377	0.989	-0.405	0.387*	0.996
1st Anal Spine Length	5.224	0.025	0.732	1.242	0.035*	0.939
2nd Anal Spine Length	10.160	0.053	0.870	3.983	0.078*	0.953
3rd Anal Spine Length	11.967	0.063	0.900	2.726	0.100*	0.977

*Slope (regression coefficient) in this hybrid is greater than corresponding slope in the other hybrid.

No comparisons could be drawn between hybrids and parental species because no comparable regression equations were found in the literature. Lund (1957) published a morphometric study in which similar regressions were used to distinguish striped bass populations, but did not include the equations.

Hubbs (1955) noted that it is "an almost universally valid rule" that hybrids are intermediate between their parents in their morphological characteristics. In general, the "rule" is valid, but Alm (1955) and Simon and Noble (1968) pointed out that some hybrids may more closely resemble one parent in specific characteristics, or they may differ from both parents in some characteristics. In general, hybrid ratios of the *Morone* hybrids were intermediate between those of the parents, but there were exceptions. The mean HL/4DSL value for the SB X WB hybrids was less than the published values for either of the parental species and the mean value for 2ASL/3ASL was greater than that of the parents. For the SB X WP hybrids, the mean value for SL/HL was lower than values for either of the parents (Table 3).

Judicious use of the morphometric characters, combined with previously published general descriptions and meristic characters for the hybrids, should allow positive identification of either of the *Monrone* hybrids described herein.

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