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Meristic Variation in *Sebastes* (Scorpaenidae), with an Analysis of Character Association and Bilateral Pattern and their Significance in Species Separation

Lo-chai Chen

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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ABSTRACT

This report presents meristic data for nearly all of the known species of *Sebastes*. Rudimentary caudal ray counts tend to be higher in more active species. The number of caudal rays supported by the hypurals is consistently 14, whereas the number of branched caudal rays varies between 11 and 13. Vertebral counts and most fin-ray counts tend to be lower in species or populations in warmer latitudes, except for pectoral ray counts which tend to have an opposite geographic pattern. On the basis of the small magnitude of meristic and morphometric differences and the lack of other differences between northern and southern samples of "*Sebastes caurinus*," *Sebastichthys vexillaris* Jordan and Gilbert is regarded as a junior synonym of *Sebastes caurinus* Richardson. The patterns of bilateral variation in paired meristics are analyzed and their mechanism discussed. The frequency distribution of pectoral ray counts in their right-left combination is shown to be useful in species separation. No association was found between any combination of two meristic features in any species. The author proposes that intrasample associations between meristic features are evidence of sampling heterogeneity.

INTRODUCTION

Meristic characters, in a strict sense, are countable structures, the numbers of which are associated with body segmentation. In practice, however, any enumerable feature can be referred to as a meristic character. Features of this kind are easy to examine, require no subjective numerical conversion in analysis, and are important in fish identification and species separation. This is especially true in fishes of the genus *Sebastes* in which there are very few other characters available, particularly when dealing with larval or juvenile specimens.

This paper provides baseline meristic data of species of the genus *Sebastes*, discusses the mechanics and patterns of interspecific, individual, geographic, and bilateral variation, and the use of these patterns in species separation.

MATERIALS AND METHODS

More than 4,000 specimens of 100 species of *Sebastes* have been examined in this study. Additional data (see footnotes in Table 1) were gathered from the literature. Robert Lea (California Department of Fish and Game) provided data on two specimens of *S. gillii* and two specimens of *S. brevispinis*, and Jergen Westrheim (Pacific Biological Station, Nanaimo, B.C., Canada) provided pectoral ray counts of 52 specimens of *S. polyspinis*.

In counting rays of dorsal and anal fins, the two last rays are counted as one when they are in contact at their bases, without interspace, as is usually the case. When a space gap is obvious between the bases of the two last rays, however, they are counted separately. In counting lateral-line pores, the total number of pores is given without reference to placement of the structural base of the caudal fin. Gill-raker counts are the total number of rakers on the outer row of the first gill arch, including all the rudimentary ones. In vertebral counts, the ural centrum, with the upturned urostyle, is counted as the last vertebra. Principal caudal ray count is the number of branched caudal rays plus 2 and may not be the same as the number of caudal rays supported by the hypurals. Rudimentary caudal rays are small fin-rays preceeding the principal caudal rays at the upper and lower edge of the caudal fin.

In tabulating data of pectoral, dorsal, and anal soft-ray counts, instead of using the conventional frequency distribution format, the frequency distribution of the extent of deviation from the modal number is given. This modified format conserves space and provides a clearer picture of the overall pattern emphasized in this report.

RESULTS AND DISCUSSION

Data on the vertebral numbers and principal caudal ray counts, dorsal spine and dorsal soft-ray counts, anal soft-ray and pectoral ray counts, gill-raker counts, and lateral line pore counts are presented in Tables 1, 2, 3, 4, and 5, respectively.

Data on anal spine counts are not tabulated. All of the 2,765 specimens of the 91 species examined for this feature have three anal spines.

Caudal ray counts

Counts of rudimentary caudal rays are presented in Table 6. Rybachuk (1976) examined the rudimentary caudal ray counts in *S. jordani* and *S. nebulosus* and reported higher counts in the more active swimming *S. jordani*. The data in Table 6 are arranged in descending order by caudal ray counts. The resulting pattern does support Rybachuk's contention. In general, species with higher counts (upper table) tend to have slender bodies, small dorsal and anal fins, and their dorsal, anal, and caudal fins have straight distal profiles and sharp corners, typical for active swimming fish. Species with lower counts (lower table), however, tend to have robust bodies, large dorsal and anal fins, and the distal profiles of their dorsal, anal, and caudal fins are rounded, typical of slow swimming but highly maneuverable fish. Although closely related species (such as the *entomelas-rufus-ovalis-hopkinsi* group and the *exsul-ensifer-lentiginosus-capensis-helvomaculatus* group) tend to appear near one another in the table, the same is true of remotely related species, suggesting evolutionary convergence.

The principal caudal ray counts show inter- and intra-specific variation (Table 1). In the majority of species the modal count is 14. In the three species of the subgenus *Sebastiscus* (*albofasciatus*, *marmoratus*, and *tertius*) the count tends to be 13, and in species of the subgenera *Mebarus* (*inermis*, *joyneri*, *thompsoni*, and *atrovirens*) and *Takenokius* (*vulpes*, *zonatus*, *ijimae*, *trivittatus*, *nivosus*, and *oblongus*) the count is often 15.

Principal caudal ray counts were made by adding two to the number of branched caudal rays. This definition is different from that of some other workers who define principal rays as those rays supported by the hypurals. From radiographs, I find that in all specimens of *Sebastes* examined there are 14 caudal rays supported by the hypurals and one supported by the parhypural. When there are 11 branched caudal rays (thus a principal caudal ray count of 13 by my definition), the two uppermost and the two lowermost rays supported by the hypurals and parhypural are unbranched. When there are 12 branched caudal rays, the two uppermost rays supported by the hypurals and the ray supported by the parhypural are unbranched. When there are 13 branched caudal rays, the uppermost ray supported by the hypurals and the ray supported by the parhypural are unbranched.

In higher teleosts the reduction of principal caudal rays from the dominant count of 17 (Greenwood et. al. 1966) seems often to be associated with abandonment of an active swimming mode of life, as seen in Cottids, Gobiids, Callionymids, and Blenniids. Many of the species of *Sebastes* do swim quite actively and should not be expected to have low principal caudal ray counts. That counts of 13, 14, or 15 in *Sebastes* are lower than the usual 17 in active-swimming higher teleosts, but higher than observed in other Scorpaenids (Chen 1981) which are basically inactive bottom-dwellers, suggests that in terms of evolution the active swimming life in *Sebastes* is a secondary event and that *Sebastes* probably was evolved from a benthic scorpaenid. This is contrary to a once-popular opinion that *Sebastes* is an offshoot at the base of the scorpaenid phylogenetic tree (Matsubara 1943).

Vertebral numbers

Counts for a given species were made mostly from samples within a limited geographic area. This may have attributed to the intra-specific constancy in the data. However, the 49 counts of *S. diploproa* were combined from two widely separated samples, one from off British Columbia and the other from off Southern California, and no variation is observed. Samples of *S. entomelas* and *S. phillipsi* demonstrate some intraspecific variation, although the small sample size precludes any judgment as to the significance of such variation. It is clear, however, that such variation is not related to geography as all of the counts of these two species are from specimens taken between San Francisco and Los Angeles, California.

Although little intraspecific variation is observed, interspecifically a geographic trend is obvious. In the subgenus *Allosebastes*, the northern species group *proriger-variegatus-zacentrus-emphaeus-wilsoni* has 27 vertebrae, while the southern species group *semicinctus-saxicola-sinensis-diploproa-cortezi-peduncularis-varispinis* has 26. *Sebastes aleutianus* and *S. borealis*, the two northern counterparts of the 26-count southern *S. melanostomus*, both have 27 vertebrae. *Sebastes ciliatus*, the northern counterpart of the 26-count *melanops-mystinus-serranoides-flavidus* group, has 28 vertebrae. The two northern trans-Pacific species *S. alutus* and *S. polyspinis* have high counts of 27 and 28, respectively. The only exception is the predominantly southern subgenus *Acutomentum*, represented by *S. ovalis*, *S. rufus*, *S. entomelas*, and *S. hopkinsi*, which has a count of mainly 27 rather than 26. That all four species of *Acutomentum* are southern but have 27 vertebrae, and the condition in the two species groups of *Allosebastes* discussed above, suggest that in addition to the latitudinal trend, vertebral number probably has phylogenetic implication.

Geographic trends in fin-ray counts

The geographic trend in vertebral counts, with lower numbers in southern species, seems true in some of the fin ray counts as well. In examining the number of dorsal fin rays (Table 2) and anal soft-rays (Table 3), I find that species endemic to the Gulf of California (*cortezi*, *exsul*, *peduncularis*, *sinensis*, *spinorbis*, and *varispinis*) tend to have reduced meristic elements, sometimes with only 11 dorsal soft-rays and 5 anal soft-rays. More peculiar, however, is the possession of only 12 dorsal spines in over 20% (10 out of 48) of the specimens of *S. varispinis*. Dorsal spine number in *Sebastes* is a very conservative character. Table 2 presents the dorsal spine counts of *Sebastes*, including those documented by Chen (1971 and 1975) and Matsubara (1943). Of the 2,571 specimens used in Table 2, only 24 have counts below and 27 above the modal number (2% deviation). It must be noted that 17 of the 51 (33%) deviations are from a sample of 227 specimens (9% of the 2,571 total) of seven species from the Gulf of California, and 10 of the 17 are of *S. varispinis*.

An analysis of the data of *S. varispinis* indicates that the numbers of dorsal spines and dorsal soft-rays are negatively correlated (Table 7, $\chi^2 = 5.109$, $\alpha = 0.025$), suggesting either that the reduction in dorsal fin elements in the warm environment of the Gulf of California does not discriminate between spiny-rays and soft-rays, or that evolution is in the process of transforming spiny-rays into soft-rays. In *S. sinensis*, although the number of dorsal soft-rays has been reduced from 12 to 11, as judged from the fact that this is the only species of *Sebastes* with less than 12 dorsal soft-rays (Table 2), the low dorsal spine count of 12 occurs only rarely (3 out of 68). In the three species of *Sebastiscus* (*albofasciatus*, *marmoratus*, and *tertius*), the only subgenus of *Sebastes* occurring in the tropics, the number of dorsal spines has been reduced to 12, whereas the number of dorsal soft-rays remains at 12. (Although I believe that *Sebastes* came from a tropical low meristic ancestor, I regard the condition of low meristic numbers in *Sebastiscus* as a secondary event.) That low dorsal soft-ray count has resulted in one line of evolution, whereas low dorsal spiny-ray count has resulted in another line of evolution, suggests that in the process of reducing dorsal fin elements, natural selection does distinguish between spiny-rays and soft-rays, ruling out the first hypothesis proposed above to explain the negative correlation between spiny ray number and soft-ray number in the dorsal fin of *S. varispinis*.

Chen (1971) explained the low anal soft-ray count in *S. sinensis* as a feature favored in warm waters, either directly by natural selection or indirectly, because of the selective advantage of the other pleiotropic expressions of the controlling genes. This is substantiated by the meristic reduction in the Gulf of California endemics herein reported and the high number of vertebrae, dorsal spines, dorsal soft-rays, and anal soft-rays in the cold temperate *S. polyspinis* (28, XIV, 13-16, 7-9), *S. glaucus* (29, XIV, 15, 8), *S. owstoni* (30, XIV, 14, 9), *S. marinus* (31, XV, 14-15, 8-9), *S. mentella* (30, XV, 14, 8-9) and *S. fasciatus* (30, XV, 13-14, 7-8) (Westrheim and Tsuyuki 1971; Matsubara 1943; Kelly et al. 1961).

In contrast to the trend of lower meristic counts in southern forms discussed above, the number of pectoral rays in *Sebastes* seems to vary in the opposite direction, being higher in southern forms. This is exemplified by the pattern seen in the subgenus *Sebastomus* which has a predominant pectoral ray count of 17. In this subgenus the only northern species, *S. helvomaculatus*, has 16 pectoral rays whereas species with greater tropical affinity (including the *S. capensis* complex which has successfully crossed the tropics, *S. spinorbis* which is endemic to the Gulf of California, and *S. notius* which is known only from off Baja California) tend to have 18 pectoral rays. It must be pointed out that all *Sebastomus* species in the Gulf of California are deep-living, and the crossing of tropics by the *capensis* complex could have involved submergence. Thus there is the possibility that the geographic pattern described above is caused by a bathymetric effect, as demonstrated by the *chlorostictus-rosenblatti-eos* group in which the deep water *S. eos* is the only other species of *Sebastomus* possessing 18 pectoral rays. The *saxicola-sinensis-cortezi-diploproa* complex of the subgenus *Allosebastes* serves as another example, with 16 pectoral rays in *S. saxicola* off the coast of California and Washington, but with 18 pectoral rays in *S. cortezi* and *S. sinensis* of the Gulf of California and in *S. diploproa* which is believed to have reinvaded the outer coast from the Gulf of California (Chen 1975). This trend seems also to be true intraspecifically when one compares conspecific samples from waters of different temperature. For example, *S. diploproa* tends to have more pectoral rays in individuals from southern populations (Table 8), and *S. macdonaldi* tends to have more pectoral rays in individuals from the Gulf of California than those from the outer coast (Chen 1975).

Functionally it is not clear if a higher pectoral ray count in warmer water in rockfishes has any adaptive meaning. In the largely sympatric *chlorostictus-rosenblatti-eos* species complex of the subgenus *Sebastomus*, the deep- (thus cold)water *S. eos* has 18 pectoral rays whereas the shallow- (thus warm)water *S. chlorostictus* and *S. rosenblatti* have 17 pectoral rays. Taning (1952) found that in *Salmo trutta* the pectoral rays and vertebral elements responded to different temperature in opposing manners, with the former being described by a 'V'-shape curve and the latter by an 'inverse V'-shape curve.

The *caurinus-vexillaris* problem

One of the species problems in *Sebastes* taxonomy concerns the specific distinction between *Sebastes caurinus* Richardson, 1845 (type locality: Sitka, Alaska) and *Sebastichthys vexillaris* Jordan and Gilbert, 1880 (type localities: Santa Barbara Channel and San Francisco). The type of *S. caurinus* no longer exists, and the diagnostic features given in the original description of the species do not distinguish it from the types of *S. vexillaris* (USNM 26997 and 27087). To date, no morphological distinctions are known that can serve to separate the two nominal species. Phillips (1957) used the width of orbit to separate the two species (northern and southern samples of "*S. caurinus*"), but later (Phillips 1968) admitted such separation to be unsatisfactory.

Through analysis of covariance, I have compared 28 different body measurements [see Chen (1971) for list of measurements] between two samples, 23 specimens of *S. caurinus* from Puget Sound and 29 specimens from off Southern California, and find that the two samples are statistically different in preanal length, head length, pectoral fin length, pelvic fin length, upper peduncle length, and length of first anal spine. The differences, however, are well within the magnitude of intraspecific geographic variation observed in other species of *Sebastes* (Chen 1971 and unpubl. data). Meristically, samples of what I regard as *S. caurinus* from different geographic regions are different in gill-raker counts and lateral line pore numbers (Tables 8, 9, 10); but considering the allopatric relationship among the samples, the differences are not of a magnitude to warrant species separation. Although to a lesser extent, similar differences between northern and southern samples can be seen in *S. paucispinis*, *S. diploproa*, and *S. elongatus* (Tables 8, 9, 10). Although conspicuous geographic variation in meristics in *Sebastes* probably is not a common event (Chen 1971), clinal variation in diagonal scale row counts has been documented (Westrheim 1965) for *S. zacentrus*. All of the above seems to support my earlier contention (Chen 1975) that *S. vexillaris* should be regarded as a junior synonym of *S. caurinus*.

Lack of sexual dimorphism

Sexes in *Sebastes* can be determined through morphology of the genital papillae. There is no other documented sexual dimorphism in fishes of this genus. Tables 8, 9, and 10 also compare various meristic features between sexes in *S. semicinctus*. This species is different from other species of *Sebastes* in being sexually dimorphic in size, with females growing significantly larger than males (personal unpubl. data). Meristically, however, no sexual difference is detected, as evidenced in the tables.

Bilateral pattern and its significance in species separation

The biological species concept, advocated by Mayr (1963), defines a species as a group of populations separated from other population groups by irreversible genotypic gaps, and that such irreversible gaps are maintained by reproductive isolation. In practice, however, the irreversibility of such a gap is often not determinable and can be inferred only by consistent phenotypic discontinuity. Such inferences are subjective and are based on the assumption that hybrids are phenotypically intermediate, and the absence of intermediate forms indicates lack of interbreeding.

In separating species of *Sebastes*, meristic characters play a very important role; however, meristic features, by their nature, have discontinuous distributions. The numerical gap between succeeding counts may or may not indicate the presence of a genotypic gap. The utilization of a numerical gap between succeeding counts as inference of the existence of a biological gap between species is thus a difficult task.

The conventional means of presenting pectoral ray numbers of a species of fish is either to give the modal number and then the range of variation, or to give the frequency distribution of unilateral counts. In this kind of presentation, it is difficult to distinguish between a high degree of intraspecific variation, such as that in *S. eos*, *S. jordani*, *S. serranoides* or *S. maliger* (Table 3), or a case of sampling heterogeneity, such as in Tables 11 and 12 in which the data of two different species are purposely lumped.

When the pectoral ray counts are presented in their right and left combination, however, the picture is different. In the combined data of *S. serranoides* and *S. flavidus* and of *S. proriger* and *S. aleutianus*, bimodality is clearly demonstrated, with two modes at 17,17 and 18,18, but with very few intermediates of 17,18 rays (Tables 11, 12). Valentine et al (1973) used the degree of bilateral meristic asymmetry in fishes as a measure of environmental stress, with the assumption that in these animals asymmetry is a result of developmental perturbation. The view that vertebrates are genetically and bilaterally symmetrical and that the right and left halves of the body are under the same genetic control is probably held by a large number of zoologists. If this is true in *Sebastes*, then the low frequency of occurrence of the intermediate 17,18 combination, in comparison with those of 17,17 and 18,18 demonstrated in Tables 11 and 12, is to be expected, regardless of the degree of homogeneity or heterogeneity of the sample.

In examining the bilateral pattern of pectoral ray numbers in presumably homogeneous samples of different species of *Sebastes* (Table 13), however, the picture becomes different. Of 2,551 specimens of 68 species of *Sebastes* included in Table 13, most (87%) are bilaterally symmetrical. This high degree of bilateral symmetry, however, seems to have to do with the low degree of deviation of pectoral ray counts from their modal number. It seems that the tendency for the left and right pectoral fins to have the same number of rays is because the two are highly channelized toward the same modal number and tend not to deviate from this modal number. The probability of deviating from the modal number is low, and the probability of having deviation on both sides of the same body is even lower. Thus when there is deviation from the modal number, bilateral symmetry tends to break down. In Table 13, about 20% of the specimens show deviation from the modal number; of these, bilaterally asymmetrical specimens outnumber bilaterally symmetrical specimens almost 2 to 1. The above evidence seems to suggest that in *Sebastes* the right and left pectoral ray numbers are of independent genetic control. Although both the left and right pectoral ray numbers are subjected to the same selective forces and tend to be channelized toward the same optimum number, they are not mandatorily identical.

Most species of *Sebastes* are probably stabilized at a condition in which the genotypic mode of the pectoral ray number is the one favored by natural selection. In species at stages of evolutionary transition, however, when the genotypic mode of the pectoral ray number does not coincide with the mode favored by natural selection, or when the natural selective force on the modal number is relaxed (resulting in an increase in the relative strength of the selective force for bilateral symmetry), the distribution pattern of pectoral ray combinations in the population can be modified. This probably explains the few exceptions to the usual pattern observed in Table 13 (*S. aurora*, *S. miniatus*, and *S. serriceps*). One can postulate that these could represent cases of ongoing sympatric divergence, a speciational mode probably used more often in this speciose genus than in most of the other fish groups.

Because of the wide range of variation, the data of gill-raker counts and those of lateral-line pore counts cannot be presented in the form of frequency distribution tables in their right-left combinations, as in the case of the pectoral rays, but must be in the form of contingency tables (Tables 14, 15). Sampling heterogeneity cannot be detected as easily in these two paired meristics as in the pectoral rays. Analysis has been made on data of all of the species with reasonable sample size, and they all show a pattern similar to that demonstrated in Tables 14 and 15. In these two paired features the tendency for bilateral symmetry is conspicuous even in cases of deviation from the modal number. Superficially this seems to suggest mandatory symmetry, i.e., the right and left counts have to be equal because they are pleiotropically associated. The numbers of gill-rakers and lateral-line pores on one side of the body tend to be the same as those on the other side of the body. However, in specimens in which the number on one side of the body deviates from the mode, the corresponding frequency distribution of counts on the other side of the body tend to be skewed, with bunching toward the modal number (Tables 14, 15). Although bilateral symmetry and optimum meristic number are both favored by natural selection, the functional reasons may be different. When the right and the left elements are under independent genetic controls, the attainment of symmetry and of the optimum number do not have to be concurrent.

Character association and its significance in species separation

Tables 2 and 3 show that the dorsal and anal soft-ray counts in *Sebastes*, like the pectoral ray counts, have little variability, with a conspicuous mode in their distribution, and a deviation from the mode rarely greater than one. Since these features are not paired, the data cannot be presented in the form of right-left combinations to distinguish sampling heterogeneity from high variability. In this case, sampling heterogeneity can be detected through the occurrence of character association.

Contingency tables have been constructed for any combination of two different meristics for all species examined. With the exceptions of the association between dorsal spine and soft-ray numbers in *S. varispinis* (Table 7) and the association between right and left counts discussed above, there is no indication of association between any two meristics. Tables 7 and 16 are examples of such analysis. Data in these tables demonstrate that there is no pleiotropic association between different meristics, that is, different meristic features have separate unlinked genetic determinants. Intraspecifically, genetically based variation in a meristic feature would not mandate the other features to vary in a predetermined direction. Any intrasample association between different meristics thus would suggest sampling heterogeneity. Table 12 represents the combined data of *S. aleutianus* and *S. proriger*, and Table 11 represents the combined data of *S. serranoides* and *S. flavidus*. In Table 12 there is definite association between dorsal soft-ray number and pectoral ray count, and in Table 11 the numbers of dorsal soft-rays and pectoral rays, the numbers of anal soft-rays and dorsal soft-rays, are clearly correlated, as well as the numbers of anal soft-rays and pectoral rays. This kind of association is probably functionally significant, and the existence of such an association suggests the presence of more than one adaptive peak, each represented by a meristic combination.

From the above discussion, it seems reasonable to conclude that when dealing with sympatric samples of *Sebastes*, bimodality in the distribution of pectoral ray counts in their right-left combination and association between different meristic features can be used as a basis for species separation.

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Table 1.—Vertebral number and the number of principal caudal rays in *Sebastes*.

	Vertebrae								Principal caudal rays			
	25	26	27	28	29	30	31	32	13	14	15	16
albofasciatus	14								22	1		
aleutianus			4						5	14		
alutus			13							6		
atrovirens		11								9	2	
auriculatus		10	1						8	23		
aurora		6								4		
babcocki		10								7		
borealis (1,8)			68	1						1		
baramenuke (6)		12	1							4		
brevispinis		1								1		
capensis		9								2		
carnatus		5							2	6	1	
caurinus	1	7								15		
chlorostictus		6								7		
chrysomelas		6								5	1	
ciliatus				5						6		
constellatus		6								5		
cortezi		33							2	6	1	
crameri		6								6		
dallii		15	1						2	8		
diploproa		49								9	1	
elongatus		16							1	16		
emphaeus			15	1					1	12	1	
ensifer		5								13		
entomelas		3	2							2		
eos		2								2		
exsul		8								8		
fasciatus (5)						23	9					
flammeus (6)	1	30								1		
flavidus		6								11		
gillii		3								3		
glaucus (6)					18	1						
goodei		12								11		
helvomaculatus		5								6		
hopkinsi			19							18		
hubbsi (6)	1	40	1						2	10	3	
ijimae		3									5	
inermis		41							3	9	11	3
iracundus (6)		1	1									
itinus (6)		16								2		
jordani		12								10	1	
joyneri (6)	1	22								3	7	
lentiginosus		3								2	1	
levis		2								1		
longispinis (6)	4	54	3						1	2		
macdonaldi		23								10		
maliger		1								5		
matsubarae (6)		31										
marinus (5)						16	80	1		3		
marmoratus	50	1							25	6		
melanops		4								17		
melanosema		2										
melanostictus (6)			6									
melanostomus		5								4		
	25	26	27	28	29	30	31	32	13	14	15	16

Table 1.—Continued.

	Vertebrae								Principal caudal rays			
	25	26	27	28	29	30	31	32	13	14	15	16
mentella (5)					3	76	10					
minor (2)			80	1								
miniatus		8								8		
mystinus		17	1						3	16		
nebulosus		7							1	3		
nigrocinctus		5							2	3		
nivosus (6)		9								1	7	
notius		1								1		
nudus		3								5	3	
oblongus (6)		52	2						1	10	12	
ovalis (4)			7							7		
owstoni (6)				1	9	117	1		1	5		
pachycephalus		6								5	3	
paucispinis		5								8		
peduncularis		2										
phillipsi		10	3							8	1	
pinniger		5								10		
polyspinis				8						5		
proriger			10							15		
rastrelliger		9							2	21	5	
reedi (9)		2								1		
rosaceus		7								9		
rosenblatti		9								5		
ruberrimus		1								1		
rubrivinctus		4								5		
rufinanus			2							2		
rufus (4)			6	1							1	
saxicola		22							2	8		
schlegeli (6)		74	1						5	18	3	1
scythropus (6)		18								3		
semicinctus		40							1	25		
serranoides		13								3		
serriceps		7								16	4	
simulator		2								4		
sinensis		25							1	9		
spinorbis		4										
steindachneri (3,6)				16					1	2		
taczanowskii (6)		57	3							1		
tertius	16								13	9	2	
thompsoni (6)		20								2		
trivittatus (6)		29								2	3	
umbrosus		12								7		
variegatus (7)			4							3		
varispinis		32										
viviparus (5)					2	116	3					
vulpes		5									4	
wakiyai (3)												
wilsoni			17	1					1	12	2	
zacentrus			20							2		
zonatus		6								1	5	
	25	26	27	28	29	30	31	32	13	14	15	16

Numbers in parentheses behind species names indicate literature sources of data (in part or whole) for this study. (1) Barsukov 1970; (2) Barsukov 1972; (3) Barsukov 1973; (4) Fong 1968; (5) Kelly et al. 1961; (6) Matsubara 1943; (7) Quast 1971; (8) Tsuyuki and Westrheim 1970; (9) Westrheim and Tsuyuki 1967.

Table. 2—Pattern of individual variation in dorsal spine number and dorsal soft-ray number in *Sebastes*.

	Dorsal spines					Dorsal soft-rays					
	11	12	13	14	15	−2	−1	0	1	2	Mode
albofasciatus		18						32			12
aleutianus			21	1			5	15	1		14
alutus			14	1		1	1	10	3		15
atrovirens			22				4	16	1		14
auriculatus			19				2	16	2		13
aurora			18				5	13			13
babcocki			29				4	20	5		14
baramenuke			5				6	7			14
borealis			1				13	83	41	5	13
brevispinis			9				2	5	3		14
capensis			33				1	29	4		13
carnatus			32				4	16			13
caurinus			67			1	14	50	2		13
chlorostictus			143				1	99	45		12
chrysomelas			20				2	16	2		13
ciliatus			24				2	18	3		15
constellatus			133	2			14	110	19		13
cortezi		1	35				7	28			12
crameri		1	20					11	9	1	13
dallii		1	27	1			4	20	5		13
diploproa			62				1	31	28	2	12
elongatus			47				9	35	3		13
emphaeus			24				1	21	2		14
ensifer			46				8	29	4		13
entomelas			19				1	16	2		15
eos			42				1	31	10		12
exsul			35		1		18	18			13
fasciatus							19	27	3	1	14
flammeus			3				11	19	1		14
flavidus		1	16					12	8		14
gillii			6					4	1	1	13
glaucus				1			3	14	2	1	15
goodei			14				4	10			14
helvomaculatus		1	71	1			9	69	4		13
hopkinsi		1	22	1			14	36	2	2	15
hubbsi						1	10	32	2		12
ijimae			20				7	13			13
iracundus			3				1	6	1		13
itinus			1	1			4	12			14
jordani			22				2	11	8	1	14
joyneri			8				3	13	2		14
lentiginosus			20					18	2		12
levis			15	1			7	9			13
longispinis						1	12	62	2		13
macdonaldi		2	53	1			8	26	3		13
maliger			22			4	15	3			13
marinus						3	14	17	4		15
marmoratus		75	2				2	121	8		12
matsubarae						1	8	21			13
melanops			12	1			6	7			15
melanosema							1	2			12
	11	12	13	14	15	−2	−1	0	1	2	Mode

Table. 2—Continued.

	Dorsal spines					Dorsal soft-rays					
	11	12	13	14	15	−2	−1	0	1	2	Mode
melanostictus							2	5			14
melanostomus			22				1	16	5		13
minor							6	140	7		12
miniatus			17				4	12	1		14
mystinus			21				4	16	2		16
nebulosus			16				1	14	1		13
nigrocinctus		1	8			1	1	6	1		14
nivosus							1	8			12
notius			4				1	3			13
nudus			7								
oblongus			2			1		41	11		12
ovalis			5			2	7	40	13		15
owstoni			2			2	17	99	9		14
pachycephalus			18								
paucispinis			41	1	1		5	33	5		14
peduncularis			2					1	1		12
phillipsi			12	1				10	3		12
pinniger			17				1	14	3		14
polyspinis			18			5	20	33	1		15
proriger			22				9	13			15
rastrelliger			20				2	18			13
reedi							1	85	15		14
rosaceus			162	1		1	53	112	1		13
rosenblatti			153	2			4	126	24		12
ruberrimus			7				1	5	1		15
rubrivinctus			27					17	11	1	13
rufinanus			2					2			14
rufus			6			1	16	24	6		15
saxicola			23				1	21	1		12
schlegeli			2				8	64	1		12
scythropus								19			12
semicinctus			41				2	34	6		13
serranoides			34				13	21			16
serriceps			20				3	15	2		14
simulator			40				5	37	5		13
sinensis		3	62	3				41	27	1	11
spinorbis			4					2	1		13
steindachneri			2				7	28	5		14
taczanowskii			4		1		1	47	5		14
tertius	1	43	1				2	66	1		12
thompsoni			5				2	12	6		14
trivittatus			6				4	24	1		13
umbrosus		1	143	1			6	101	38		12
variegatus			9					5	4		14
varispinis		10	38				10	18	1		12
viviparus						9	165	83	3		13
vulpes			18				9	14			13
wakiyai							2	3			14
wilsoni			25	1			6	17	1		14
zacentrus			25				2	22	1		14
zonatus			16				2	22			13
	11	12	13	14	15	−2	−1	0	1	2	Mode

Table 3.—Pattern of individual variation in anal soft-ray number and pectoral ray number in *Sebastes*.

	Anal soft-ray						Pectoral ray					
	−2	−1	0	1	2	Mode	−2	−1	0	1	2	Mode
albofasciatus			32			5		2	52	9		17
aleutianus			20	1		7		1	38	3		18
alutus		3	11	1		8		5	22	2		18
atrovirens		5	16			7		5	36	1		17
auriculatus		2	17			7	1	2	32	3		18
aurora		1	16	1		6			19	15	3	17
babcocki		3	24	2		7	2	8	47	1		19
borealis		9	109	25		7	3	24	66	3		19
baramenuke		1	11	1		8			7	6		18
brevispinis			10			7		7	12			18
capensis		3	29	2		6		3	61	5		18
carnatus			20			6			42			17
caurinus		3	58	6		6		1	113	24		17
chlorostictus		6	136	3		6		24	251	1		17
chrysomelas		1	17	2		6			34	6		17
ciliatus	1		23	1		8		2	44	4		18
constellatus		3	136	2		6		15	253	8		17
cortezi		6	29			6		12	49	9		18
crameri			21			7		1	32	8		19
dallii			28	1		6		5	53			17
diploproa	1	11	50			7		22	103			18
elongatus		1	44	1		6		8	84	1		17
emphaeus		3	21			7		1	46	1		17
ensifer		2	35	3		6		4	74	6		17
entomelas		1	18	1		8			39	1		18
eos		1	39	3		6		24	62			18
exsul		3	32			6		2	63	7		17
fasciatus		1	30	20		7	1	14	42	2		19
flammeus			28	3		8			20	11		19
flavidus		2	17			8		1	39			18
gillii		1	5			7			7	5		18
glaucus		1	16	2		8		1	16	2		19
goodei			13	1		8		1	26	1		17
helvomaculatus			81	3		6		4	135	29		16
hopkinsi		4	20			7		3	43	2		17
hubbsi		2	42	1		6		1	21	1		17
ijimae		2	17	1		6	1	1	39	1		17
iracundus			4	4		8		1	4	3		19
itinus			15	1		7		1	13	2		19
jordani			16	6		9		1	28	14	1	20
joyneri		1	22			7			21	2		16
lentiginosus			18	2		6		5	36	5		17
levis		1	15			7		4	28			18
longispinis		4	72	1		6			20			16
macdonaldi			37			7		3	61	16		19
maliger		2	20			7		1	33	10		17
matsubarae		6	24			7		1	26	3		19
marinus	3	16	18	1		9		1	32	5		19
marmoratus		1	124	5		5		31	213	20		18
melanops		3	9	1		8		7	19			19
	−2	−1	0	1	2	Mode	−2	−1	0	1	2	Mode

Table 3.—Continued.

	Anal soft-ray						Pectoral ray					
	−2	−1	0	1	2	Mode	−2	−1	0	1	2	Mode
melanosema			3			6		2	4			18
melanostictus			7			7			7			18
melanostomus		1	19	2		7		3	38	3		19
minor		9	83	2		7			227	57		15
miniatus		2	15			7		12	22			18
mystinus		2	19	1		9		1	39	2		18
nebulosus		1	15			7		2	30			18
nigrocinctus		1	8			7		3	15			19
nivosus			9			6		1	8			19
notius			3			6			6			18
oblongus		2	40	11		6	1	2	45	4		17
ovalis								9	51	1		18
owstoni	1	7	87	31	1	9		4	90	33		16
paucispinis		2	38	1		9		4	76	5		15
peduncularis			2			6		1	3			18
phillipsi		1	12			6			25	1		18
pinniger			18			7		1	33	2		17
polyspinis		12	25	22		8		25	90	2		18
proriger			22			7		2	42			17
rastrelliger			20			6		1	38	1		19
reedi			98	4		7		42	156	6		19
rosaceus		4	159	2		6		32	289	11		17
rosenblatti		6	149			6		5	254	33		17
ruberrimus			7			7		1	13			19
rubrivinctus		2	25	2		7		1	56	3		17
rufinanus			2			8			4			17
rufus								2	27	18		18
saxicola		1	22			7			37	5	3	16
schlegeli		6	63	4		7		13	59	1		18
scythropus			19			6			17	2		16
semicinctus		1	40	1		7		3	76	3		17
serranoides		2	31	1		9			43	23	1	17
serriceps		1	19			6			46	37	1	17
simulator		1	46			6		4	80	6		17
sinensis		25	43	1		6		12	116	9		18
spinorbis			3			6			6			18
steindachneri		6	32	1		7		9	38	4		18
taczanowskii		1	57	2		7			59	1		16
tertius			68	1		5		11	112	3		19
thompsoni		1	17	2		7		2	17	1		16
trivittatus			22	7		6		3	25	1		18
umbrosus		7	134	1		6		25	239	3		17
variegatus		1	18			7		4	70	1		18
varispinis		6	22	1		6		7	42	7		18
viviparus		41	215	5		7		13	233	15		18
vulpes		1	20			6		1	29	20		17
wakiyai		1	4			7			5	5		17
wilsoni		1	23			6		1	44	3		17
zacentrus			23	2		7		4	43	2		17
zonatus			23	1		6	1	1	48	6		17
	−2	−1	0	1	2	Mode	−2	−1	0	1	2	Mode

Table 4.—Gill raker numbers in *Sebastes*.

Species	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
albofasciatus	1	5	17	10	2																						
aleutianus									6	10	15	7	1														
alutus														2	8	6	5	8	1								
atrovirens											4	20	13	5													
auriculatus					1	3	19	15	1																		
aurora				2	7	12	15	4																			
babcocki									6	21	25	3	1														
borealis							8	12	17	19	2																
baramenuke											1	7	3	2													
brevispinis													8	4	6	1											
capensis							1		12	24	25	6															
*carnatus**						1	3	10	17	10																	
caurinus						1	5	61	51	17	3																
chlorostictus											24	67	116	56	17	2											
*chrysomelas**					1	4	14	12	7	2																	
ciliatus												1	8	11	23												
constellatus					1	15	67	96	81	16																	
cortezi						1	6	26	22	11	4																
crameri										3	11	15	9	2													
dallii										1	1	11	15	19	7	2											
diploproa												1	10	51	35	22	5										
elongatus									1	31	38	18	5														
emphaeus																	6	3	12	21	3						
ensifer														1	9	14	20	22	14	2							
entomelas														5	11	14	6	2									
eos						3	18	33	20	10	2																
exsul											2	14	24	18	10	3	1										
fasciatus										1	1	2	3	9	14	10	7	2	1								
flammeus									10	9	7	5															
flavidus														5	9	15	11										
gillii						1	2	1	3	4																	
glaucus															2	4	5	6	1		1						
goodei														2	6	8	7	3	2								
helvomaculatus								25	56	61	17	6	1														
hopkinsi																1	3	18	9	13	3	0	1				
ijimae			2	1	11	22	5	1																			
iracundus								1	4	2	1																
itinus																			3	2	8	3					
jordani																				1		3	6	15	8	7	3
joyneri														1	4	5	10	2		1							
lentiginosus														2	3	11	16	10	4								
levis									2	5	8	15	2														
macdonaldi															1	4	25	28	12	5	1	1					
maliger									2	10	21	9	2														
marinus												1	1	2	3	2	1		1								
matsubarae										13	10	6		1													
marmoratus	4	37	59	37	14	1																					
melanops														2	4	6	12	1									
melanosema														1	2	1	2										
melanostictus												2	4		1												
melanostomus										1	23	12	7	1													
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47

Table 4.—Continued.

Species	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
miniatus																4	3	2	1	2	14	8					
mystinus												2	2	5	15	13	4	2									
nebulosus							7	17	5	2	1																
nigrocinctus								10	5	1	0	2															
nivosus					5	2	2																				
notius															2	2	1	3									
ovalis									1	2	13	30	14	2													
owstoni														20	30	39	29	6	2	1							
paucispinis							7	35	33	9	0	1															
peduncularis									2	2																	
phillipsi																2	10	6	7	1							
pinniger																					6	10	16	2			
polyspinis															13	17	6	3	1								
proriger																4	9	16	12		2						
reedi										2	10	17	23	36	12	2											
rosaceus									8	51	142	84	35	11													
rosenblatti								1	2	71	113	84	24	1													
ruberrimus						2	2	2	3	3																	
rubrivinctus							4	37	18	1																	
rufinanus																	3	1									
rufus												1	7	11	23	4	1										
saxicola										1	3	16	12	7	6												
schlegeli			3	14	25	19	11	1																			
scythropus											1	11	5	2													
semicinctus																1	11	25	27	17	1	1					
serranoides												10	30	21	6												
serriceps							9	18	8	3																	
simulator								2	13	34	20	15	4														
sinensis									15	37	63	17	6														
spinorbis										1	2	2	1														
steindachneri													1	3	3	5	2										
taczanowskii													1		14	13	18	10	3								
tertius			5	21	34	24	6																				
thompsoni																1	3	7	3		1						
trivittatus				1	2	10	12	3																			
umbrosus											1	1	13	56	91	81	19	2									
variegatus																	3	8	4	2	1						
varispinis									4	12	31	6	3														
viviparus															1	8	15	17	14	5	1						
vulpes					1	4	2	11	9	8	1																
wilsoni																	1	11	18	3	8	2					
zacentrus													2	10	26	9	1										
zonatus						6	12	10	3																		
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47

Species	15	16	17	18	19	20	21	22	23	24	25
hubbsi		1		3	9	11	2				
longispinis	1	11	15	22	9	6					
oblongus			3	5	9	10	16	7	3		
rastrelliger			1		1			1	16	15	6

*The gill-raker counts are different for *S. carnatus* and *S. chrysomelas*, two species difficult to separate ($\chi^2 = 19.46$, df = 3, $\alpha < 0.001$).

Table 5.—Lateral line pore counts in *Sebastes*.

Species	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
albofasciatus																						2	11	15	8		
aleutianus			3	12	6	7																					
atrovirens									2	0	2	2	6	11	7	8	2	1									
auriculatus															1	1	2	6	8	8	11	1	2				
aurora	2	23	11	4																							
babcocki															3	7	7	9	8	12	8	1	0	1			
borealis	1	14	22	9	2																						
brevispinis																			2	7	3	2	1	1			
capensis						1	0	0	6	7	13	9	11	8	5	4	0	2									
carnatus										2	4	10	9	5	3	4	3	1	0	0	0	1					
caurinus												8	11	14	28	27	30	12	5	1							
chlorostictus								6	21	49	61	63	50	18	7	1											
chrysomelas											2	5	11	13	6	1	0	1	1								
ciliatus															1	0	2	3	7	8	7	7	5	0	3	1	
constellatus										7	12	34	42	60	54	22	15	3	4	1							
cortezi						1	0	0	4	0	5	8	7	11	18	5	0	1									
crameri													1	0	2	3	5	4	6	7	4	4	1	2			
dallii										4	1	2	8	13	9	9	8	2	0	0	1	0	0	1			
diploproa					2	5	11	8	7	16	4	4	2	3	1												
elongatus										1	3	2	6	9	16	26	18	8	3	1							
emphaeus													3	9	8	15	6	1	2								
ensifer							1	2	4	5	14	12	17	7	7	5	4										
eos							1	3	6	12	20	12	10	8	2												
exsul							2	3	5	6	21	16	8	7	2	1											
gillii													1	1	0	2	2	3	1								
helvomaculatus							1	5	6	20	32	24	25	25	17	8	2	1									
ijimae			1	6	7	11	6	3	6																		
lentiginosus						1	2	6	8	10	6	3	1	1													
levis																		1	1	4	2	8	7	5	1	1	
maliger							1	0	4	4	8	4	11	4	2	3	0	1									
marmoratus																				1	3	10	27	49	49	8	1
melanosema								2					1	2		1											
melanostomus	1	2	9	18	6	3																					
miniatus														2	2	4	5	4	7	7	1						
mystinus																				2	3	7	14	7	5	4	
nebulosus											2	3	7	11	4	5											
nigrocinctus									1	0	0	0	0	1	0	6	3	5	1								
notius						1	0	0	2	1	0	1	1														
peduncularis												1	1		1												
phillipsi		2	8	7	6	1																					
pinniger													2	2	9	7	5	6	4	1							
polyspinis																2	5	7	6	11	5	1	1	0	0	2	
rastrelliger													2	1	1	3	5	4	12	6	5	1					
rosaceus									1	10	16	44	69	72	61	32	19	3	1								
rosenblatti							1	3	14	38	73	55	52	29	17												
ruberrimus												2	2	2	1	2	1	2									
rubrivinctus															2	7	12	14	11	8	3	3					
rufinanus			2	1		1																					
saxicola								1	4	8	10	12	3	3	1	1											
semicinctus													1	3	5	8	15	15	15	10	9	1	1				
serriceps																			1	1	8	3	5	8	7	3	2
simulator						3	10	16	13	29	10	6	1														
sinensis									1	1	8	20	14	15	10	10	2	4	1								
spinorbis						1	0	1	1	1	2																
tertius																						4	6	25	35	9	3
umbrosus						1	3	22	29	60	58	40	30	9	10	1	1										
variegatus																1	0	0	6	5	0	2	2	0	2		
varispinis										1	5	4	10	7	2	1	2										
vulpes			1	2	6	3	6	6	8	2	0	0	0	1													
wilsoni										1	1	5	9	9	9	3	3	2	1								
zacentrus												1	3	3	13	7	7	6	3	2							
zonatus				2	2	7	8	5	3	1	1																
	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54

Table 5.—Continued.

Species	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
alutus		1	2	3	4	4	5	5	1	0	1									
entomelas										5	12	7	3	5	3	2				
flavidus					1	5	11	4	5	7	7									
goodei						1	1	4	4	9	3	5	1							
hopkinsi						1	6	7	14	7	7	2	3	1						
jordani									1	0	0	2	9	7	9	6	1	3	2	1
macdonaldi								2	9	11	13	14	6	4						
melanops			2	1	5	4	5	3	1	1	2									
ovalis	2	3	8	7	4	12	10	10	3	1	1									
paucispinis							1		1	2	6	15	12	17	16	11	2	3		
proriger				2	8	10	11	6	2	4	1									
reedi			2	3	6	16	20	30	13	8	4									
rufus					5	5	7	6	9	5	7	1								
serranoides						1	0	2	9	22	18	6	4							

Table 6.—Rudimentary caudal ray counts in *Sebastes*.

	Upper rays									Lower rays							
Species	7	8	9	10	11	12	13	14	15	7	8	9	10	11	12	13	14
reedi									1								1
paucispinis							3	1	1						2	2	1
goodei							2	2							1	1	2
proriger							5	3							1	5	2
serranoides							5	4								9	
ciliatus							1	3						1	1	2	
entomelas								2								1	1
rufus							4	3							3	3	1
ovalis						1	5	1							3	4	
hopkinsi						1	6	7	1					1	8	6	
elongatus						1	6							1	5	1	
semicinctus						5	10	1						2	10	4	
dallii						4	3							2	4	1	
melanops						3	1							2	2		
rastrelliger						2	2							3	1		
marinus						3								1	2		
exsul					6	2							2	5	1		
ensifer					2	2								3	1		
lentiginosus					3									2	1		
capensis				2	3							1	1	3			
helvomaculatus				2	1						1		1	1			
zonatus				1	5	6	1							10	3		
auriculatus					6	2	1						4	5			
atrovirens				2	2								1	2	1		
phillipsi				1	6								6	1			
chrysomelas				4	2							1	3	1			
serriceps				3	4								6	1			
marmoratus			2	3								2	3				
oblongus			1									1					
pachycephalus		1									1						
hubbsi	2	1	1							2	2						
	7	8	9	10	11	12	13	14	15	7	8	9	10	11	12	13	14

Table 7.—Meristic pattern in *Sebastes varispinis*.

	Dorsal soft-rays		
Dorsal spines	11	12	13
XII		8	2
XIII	17	21	

	Dorsal soft-rays		
Anal soft-rays	11	12	13
5	2	4	
6	8	13	1
7		1	

	Pectoral ray combinations				
Anal soft-rays	17,17	17,18	18,18	18,19	19,19
5	2		3		1
6		3	15	1	2
7			1		

	Pectoral ray combinations				
Dorsal soft-rays	17,17	17,18	18,18	18,19	19,19
11	1	2	5	1	1
12	1	1	13		2
13			1		

Table 8.—Comparison of pectoral ray counts, dorsal soft-ray counts, and anal soft-ray counts between southern and northern samples in *S. paucispinis*, *S. diploproa*, *S. elongatus*, and *S. caurinus* and between sexes in *S. semicinctus*.

	Pectoral rays						Dorsal rays					Anal rays					
	14	15	16	17	18	19	11	12	13	14	15	5	6	7	8	9	10
S. paucispinis																	
S. Calif.	3	36	3						5	13	3				2	18	1
British Columbia	1	40	2							20	2					20	
S. diploproa																	
S. Calif.				10	77		1	24	17	2		1	10	33			
British Columbia				12	26			7	11				1	17			
$\chi^2 = 6.04$																	
df = 1																	
$0.025 > \alpha > 0.01$																	
S. elongatus																	
S. Calif.			3	49	1			6	21				26	1			
British Columbia			5	35				3	14	3		1	18				
S. caurinus																	
S. Calif.			1	57	10			5	27	1		1	32				
Monterey				18	2			5	4			1	8	1			
Puget Sound				38	12		1	4	19	1		1	18	5			
S. semicinctus																	
Females			2	38	3			1	19	2			1	20	1		
Males			1	34				1	13	4				18			

Table 9.—Comparison of lateral line pore counts between southern and northern samples of *S. paucispinis*, *S. diploproa*, *S. elongatus*, and *S. caurinus* and between sexes in *S. semicinctus*.

	51	52	53	54	55	56	57	58	59	60	61	62
S. paucispinis												
S. Calif.	1			2	3	10	8	6	8	3		1
British Columbia			1		3	5	4	11	8	8	2	2
$\chi^2 = 8.83$, df = 5, $0.25 > \alpha > 0.10$												
	32	33	34	35	36	37	38	39	40	41	42	
S. diploproa												
S. Calif.	1	4	4	3	4	9	2	1	2	3	1	
British Columbia	1	1	7	5	3	7	2	3				
	37	38	39	40	41	42	43	44	45	46	47	
S. elongatus												
S. Calif.	1	3	1	5	7	10	15	7	3	1		
British Columbia			1	1	2	6	11	11	5	2	1	
$\chi^2 = 10.33$, df = 5, $0.10 > \alpha > 0.05$												
	39	40	41	42	43	44	45	46	47			
S. caurinus												
S. Calif.		4	3	16	16	17	9	1	1			
Monterey		1	2	4	4	7	1	1				
Puget Sound	8	6	9	8	7	6	2	2				
$\chi^2 = 20.70$, df = 5, $\alpha \cong 0.001$												
	40	41	42	43	44	45	46	47	48	49	50	
S. semicinctus												
Females		1	2	4	9	8	10	5	2	1	1	
Males	1	2	3	3	6	7	5	4	5			

Table 10.—Comparison of gill-raker counts between southern and northern samples in *S. paucispinis*, *S. diploproa*, *S. elongatus*, and *S. caurinus* and between sexes in *S. semicinctus*.

	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
S. paucispinis																
S. Calif.	1	13	19	7		1										
British Columbia	5	22	15	2												
$\chi^2 = 5.25$, df = 1, $0.025 > \alpha > 0.01$																
S. diploproa																
S. Calif.							6	33	29	13	5					
British Columbia						1	4	18	6	9						
$\chi^2 = 4.75$, df = 3, $0.25 > \alpha > 0.10$																
S. elongatus																
S. Calif.				16	22	10	5									
British Columbia			1	15	16	8										
S. caurinus																
S. Calif.	2	32	30	4												
Monterey		6	7	4	3											
British Columbia	2	26	11	9												
$\chi^2 = 8.10$, df = 2, $0.025 > \alpha > 0.01$																
S. semicinctus																
Females										1	6	13	16	7		
Males											3	11	10	10	1	1

Table 11.—Meristic pattern in combined data of *Sebastes serranoides* and *Sebastes flavidus*.

Anal soft-rays				Dorsal soft-rays			Pectoral rays		
7	8	9	10	14	15	16	17	18	19
2	19	31	1	12	21	21	43	62	1

	Dorsal soft-rays			Pectoral ray combinations			
Anal soft-rays	14	15	16	17,17	17,18	18,18	18,19
7	2					2	
8	9	9	1	1	1	17	
9		12	19	15	7	7	1
10			1	1			

	Pectoral ray combinations			
Dorsal soft-rays	17,17	17,18	18,18	18,19
14		1	11	
15	6	3	12	
16	11	5	3	1
Total	17	9	26	1

Table 12.—Meristic pattern in combined data of *Sebastes proriger* and *Sebastes aleutianus*.

Anal soft-rays		Dorsal soft-rays			Pectoral rays			
7	8	13	14	15	16	17	18	19
42	1	5	24	14	2	43	38	3

	Dorsal soft-rays			Pectoral ray combinations					
Anal soft-rays	13	14	15	16,17	17,17	17,18	18,18	18,19	19,19
7	5	23	14	2	20	1	17	1	1
8		1					1		

	Pectoral ray combinations					
Dorsal soft-rays	16,17	17,17	17,18	18,18	18,19	19,19
13				4	1	
14	1	8	1	13		1
15	1	12		1		
Total	2	20	1	18	1	1

Table 13.—Bilateral pattern of pectoral fin ray numbers in *Sebastes*.

	Deviation from the mode									
	0,−2	−1,−2	−1,−1	−1,0	0,0	0,1	1,1	1,2	2,2	Mode
albofasciatus			1		12	4				17
aleutianus				1	18	1	1			18
alutus			1	3	9		1			18
atrovirens			1	3	16	1				17
auriculatus	1			2	13	1	1			18
aurora					8	2	6	1	1	17
babcocki		1	3	1	22	1				19
brevispinis			2	3	4					18
capensis				3	26	3	1			18
carnatus					20					17
caurinus				1	50	8	8			17
chlorostictus			5	14	118	1				17
chrysomelas					15	4	1			17
ciliatus				2	21		2			18
constellatus			4	6	117	6	1			17
cortezi			3	6	19	5	2			18
crameri					14	3	2			19
dallii			1	3	25					17
diploproa			8	5	48					18
elongatus			1	5	39	1				17
emphaeus				1	22	1				17
ensifer			1	1	33	4	1			17
entomelas					19	1				18
eos			8	8	27					18
exsul				2	29	2	2			17
flavidus				1	19					18
gillii					2	3	1			18
goodei				1	12	1				17
helvomaculatus			4	60	9	9				16
hopkinsi				3	20		1			17
ijimae				1	18	1				17
jordani				1	11	5	4	1		20
lentiginosus				4	14	1	1			17
levis				4	12					18
macdonaldi				3	24	6	4			19
maliger				1	15	2	4			17
marmoratus			7	6	55	6	1			18
melanops			2	3	8					19
melanostomus				3	17	1	1			19
miniatus			6		11					18
mystinus			2	2	106	1	3			18
nebulosus				2	14					18
nigrocinctus			1	1	7					19
notius					4					18
paucispinis			1	2	36	1	2			15
phillipsi					12	1				18
pinniger				1	15	2				17
polyspinis			8	9	39	2				18
proriger				2	20					17
rastrelliger				1	18	1				19
rosaceus			8	16	133	7	2			17
rosenblatti				5	114	21	6			17
ruberrimus				1	6					19
rubrivinctus				1	25	3				17
saxicola					17	2	1	1	1	16
semicinctus				3	35	1	1			17
serranoides					17	8	7	1		17
serriceps					19	8	14	1		17
simulator			1	2	37	2	2			17
sinensis			3	6	52	5	2			18
spinorbis					3					18
tertius			3	5	36	1				19
umbrosus			5	14	109					17
variegatus			1		5	2	1			18
varispinis			2	3	19	1	3			18
vulpes					11	3	4			17
wilsoni				1	21	1	1			17
zacentrus				4	19		1			17
zonatus				1	13		1			17
Total	1	1	89	111	2004	157	106	5	2	
Percentage	0	0	4	7	79	6	4	0	0	

"0,0" Both right and left counts are of the modal number.
"0,−1" Count on one side is of the modal number, the other side is one less than the mode.
"−1,−1" Both right and left counts are one less than the mode.
"0,1" Count on one side is of the modal number, the other side is one greater than the mode.
"1,1" Both right and left counts are one greater than the mode.

Table 14.—Bilateral association of lateral line pore counts and gill-raker counts in *Sebastes chlorostictus*.

Lateral line pores, $\bar{x}$ = 38.6

	Left								
Right	35	36	37	38	39	40	41	42	43
35	—	1	3						
36		**3**	7	3	1	1			
37		2	**5**	4	3	2	2		
38	2		9	**9**	7	6			
39			5	4	**11**	5	2	2	1
40			2	6	6	**7**	4		
41				2	3	2	**1**	1	
42					2	2		—	

Gill-rakers, $\bar{x}$ = 33.0

	Left					
Right	31	32	33	34	35	36
31	**7**	4	2			
32	4	**13**	15	2	1	
33		13	**36**	6		
34		1	7	**18**	3	
35		1	1	1	**4**	1
36					1	—

Table 15.—Bilateral association of lateral line pore counts and gill-raker counts in *Sebastes umbrosus*.

Lateral line pores, $\bar{x}$ = 38.1

	Left										
Right	34	35	36	37	38	39	40	41	42	43	44
33				1							
34	—		1								
35		**2**	1	3	4	1	1				
36		2	**1**	5	5	1	2				
37	2	5	4	**5**	12	3	2	1			
38		1	2	7	**4**	11	2	1			
39			3	3	2	**4**	1	2	2		
40			1	2	3	2	**5**	1	2		
41							1	**1**			
42						1		1	**2**		
43										—	1

Gill-rakers, $\bar{x}$ = 35.1

	Left						
Right	31	32	33	34	35	36	37
33			**4**	1			
34		1	3	**10**	17	2	
35			1	9	**20**	12	2
36	1			3	8	**22**	8
37					1	2	**3**
38					1	1	

Table 16.—Meristic Pattern in *Sebastes sinensis*.

	Dorsal soft-rays		
Anal soft rays	11	12	13
5	17	8	
6	24	19	
7			1

	Pectoral ray combinations				
Anal soft-rays	17,17	17,18	18,18	18,19	19,19
5	2	2	16	3	2
6	1	4	35	2	
7			1		

	Pectoral ray combinations				
Dorsal soft-rays	17,17	17,18	18,18	18,19	19,19
11	1	3	32	4	1
12	2	3	19	1	1
13			1		

	Total gill-rakers (left + right)								
Anal soft-rays	58	59	60	61	62	63	64	65	66
5		4	2	2	7	5	3	2	
6	3	3	9	10	12	3	1	1	1
7					1				

Anal	Total lateral line pores (left + right)																
soft-rays	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91
5	1	2		1	1	1	1		2	1					1		
6			3	1	6		6	3	1		1	2	2				1
7										1							