Sebastes variegatus, SP. N. FROM THE NORTHEASTERN PACIFIC OCEAN (PISCES, SCORPAENIDAE)

JAY C. QUAST[1]

ABSTRACT

A new scorpaenid fish, *Sebastes variegatus*, from the Gulf of Alaska is characterized by an elongate body that tapers symmetrically anteriorly and posteriorly; presence of preocular, postocular, tympannic, and parietal spines and lack of supraocular, coronal, and (usually) nuchal spines; 18 (rarely 17 or 19) rays in the pectoral fin; a second anal fin spine that is longer than the third; black membranes in the spinous dorsal and caudal fins; a dark brown to jet black peritoneum; and a dark blotched pattern on the sides that is interrupted over the posterior 2/3 of the body by an unpigmented band along the lateral line. The known geographic range is from Unimak Pass (Aleutian Islands) to Queen Charlotte Sound (British Columbia).

On February 28, 1967, the Bureau of Commercial Fisheries RV *Murre II* obtained three specimens of a new species of rockfish from the vicinity of Point McCartney in Frederick Sound, southeastern Alaska. The specimens were captured when a 6-ft-diameter Isaacs-Kidd trawl inadvertently was allowed to touch bottom at 135 m.

The specimens were tentatively identified as *Sebastes zacentrus* but were not adequately described by Phillips' (1957) account of this species. In some respects they seemed to be intermediate between *S. zacentrus* and *S. proriger*. The evidence for an undescribed species became convincing when additional specimens were taken, and the similarity to *S. zacentrus* and *S. proriger* was underscored when several more specimens were found in old collections that had been labeled as these species.

The species is placed in *Sebastes* Cuvier in concurrence with opinions of numerous authors that northeastern Pacific *Sebastodes* are congeneric with North Atlantic *Sebastes*—including Matsubara (1943b:178); Tsuyuki, Roberts, Lowes, Hadaway, and Westrheim (1968:2494); Eschmeyer (1969:104); Chen (1969:12); and American Fisheries Society (personal communication with Reeve M. Bailey, University of Michigan, December 1969).

The name *variegatus* refers to the contrasting coloration of most specimens when fresh. According to Brown (1956:830), the word means "of different sorts, particularly colors." I suggest "harlequin rockfish" as the common name.

MATERIALS AND METHODS

The study utilized 39 specimens of *S. variegatus* and included 35 from the ichthyological collection of the National Marine Fisheries Service Biological Laboratory at Auke Bay, Alaska, and 3 from the collection at the Institute of Animal Resource Ecology, University of British Columbia, Vancouver, Canada. This series included 21 males, 13 females, and 4 of unknown sex, and no important differences were found between the sexes in measurements, counts, or coloration. Measurements on the University of British Columbia specimens were not as complete as those from the Auke Bay Laboratory; hence the numerical basis of the morphometric analysis varies by 3, depending on the character. An additional male specimen was used for electrophoretic analysis.

Methods for counts and measurements are based on Hubbs and Lagler (1949:8-15), with the following exceptions or modifications. In counts: tubed lateral line scales on caudal fin lie after hypurals; tubed scales over hypurals are included in count of tubed lateral line scales

[1] National Marine Fisheries Service Biological Laboratory, Auke Bay, Alaska 99821.

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on body; and scale rows are taken below lateral line. In measurements: standard length (SL) is measured from anterior upper lip or upper teeth, whichever is more anterior, to caudal base; head length is measured from midline on upper jaw to limit of opercular flap; interorbital width equals bony interorbital measurement; lower jaw projection equals distance that lower jaw extends anteriorly to upper jaw, projected on longitudinal axis of fish; length of gill raker equals length of raker at bend of gill arch, measured from fleshy tip to, but not including, T-shaped base; length of prenarial pore equals length of enlarged pore on anterior snout near junction of premaxilla and premaxillary process; length of subnarial pore equals length of large pore on a shelf formed by upper margin of lacrimal bone, immediately below nares; body depth (pelvic) is measured from articulation of pelvic fin spine; body depth (anal) is measured from base of anal fin anterior to first anal spine; length of pectoral fin is measured from base of uppermost ray to apex of fin when fin is aligned with longitudinal axis of fish; length of soft dorsal fin base is measured from axil of last dorsal fin spine to axil of last soft ray; length of base of anal fin is measured to axil of last ray; and length of pelvic fin is measured from articulation of pelvic fin spine to tip of fin.

Terminology for spines and ridges of head follows Jordan and Evermann (1898, II: 1765, 1768).

Sebastes variegatus SP. N.

(FIG. 1-3)

HOLOTYPE

(Original number AB[2] 69-25); 201 mm SL; male; Gulf of Alaska south of Kodiak Island (approximately long 152°25′ W and lat 56° 25′ N); on bottom in 284 m; 12 June 1969; Ted Shigyo, U.S. fishery observer on Japanese stern trawler *Kirishima Maru*. California Academy of Sciences, San Francisco, Calif. (Number CAS 24857).

[2] Museum designations: AB—National Marine Fisheries Service Biological Laboratory, P.O. Box 155, Auke Bay, Alaska 99821; BC—University of British Columbia Institute of Animal Resource Ecology, Vancouver 8, British Columbia, Canada; CAS—California Academy of Sciences, Golden Gate Park, San Francisco, Calif. 94118; SIO—University of California, San Diego, Scripps Institution of Oceanography, P.O. Box 109, La Jolla, Calif. 92037; USNM—U.S. National Museum, Washington, D.C. 20560.

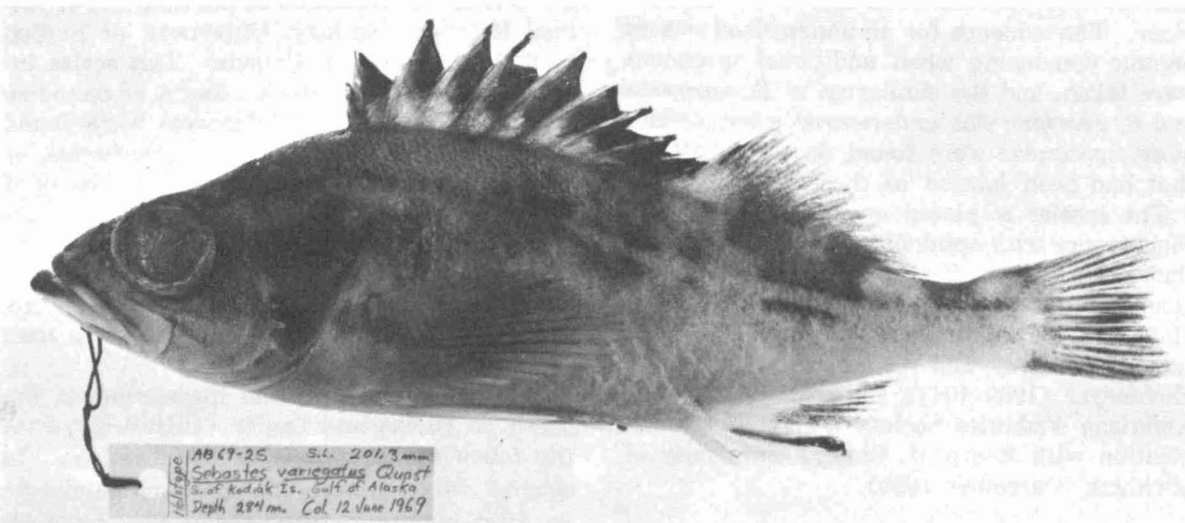

FIGURE 1.—*Sebastes variegatus* sp. n., holotype CAS 24857; 201 mm; male.

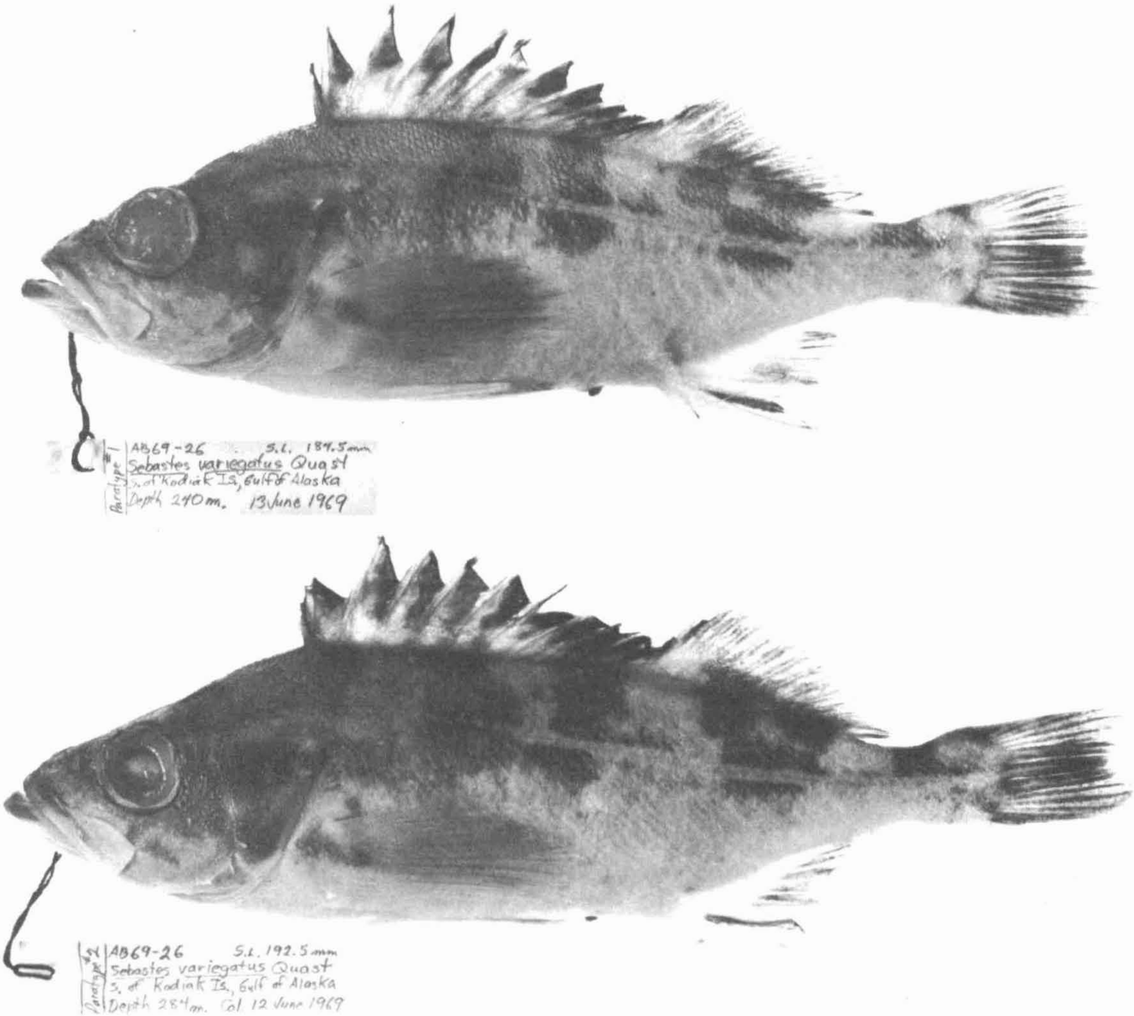

FIGURE 2.—*Sebastes variegatus* sp. n., paratypes USNM 204937 (upper) and SIO 70-171 (lower); 185 and 193 mm; both males. (Depth and date of Paratype 2 should be the same as for Paratype 1.)

PARATYPES (NOS. 1 and 2)

(Original number AB 69-26); U.S. National Museum 204937, 185 mm, and SIO 70-171 University of California, San Diego, 193 mm; males; Gulf of Alaska south of Kodiak Island (approximately long 152°25′ W and lat 56°25′ N); on bottom in 240 m; 13 June 1969; Ted Shigyo, U.S. fishery observer on Japanese stern trawler *Kirishima Maru*.

OTHER MATERIAL

WESTERN GULF OF ALASKA. Davidson Bank: AB 68-598 (3, 175-182 mm SL), 26 October 1968, RV *Miller Freeman*. East of Simeonof Is.: BC 65-70 (2, 145-196 mm SL), 5 August 1964, *G. B. Reed*. Kodiak Island vicinity: AB 67-171 (1, 235 mm SL), 19 April 1964, *Taiyo Maru No. 81*; AB 67-22 (1, 277 mm SL), 21 April 1967, *Yutaka Maru;* AB 66-154 (1, 286

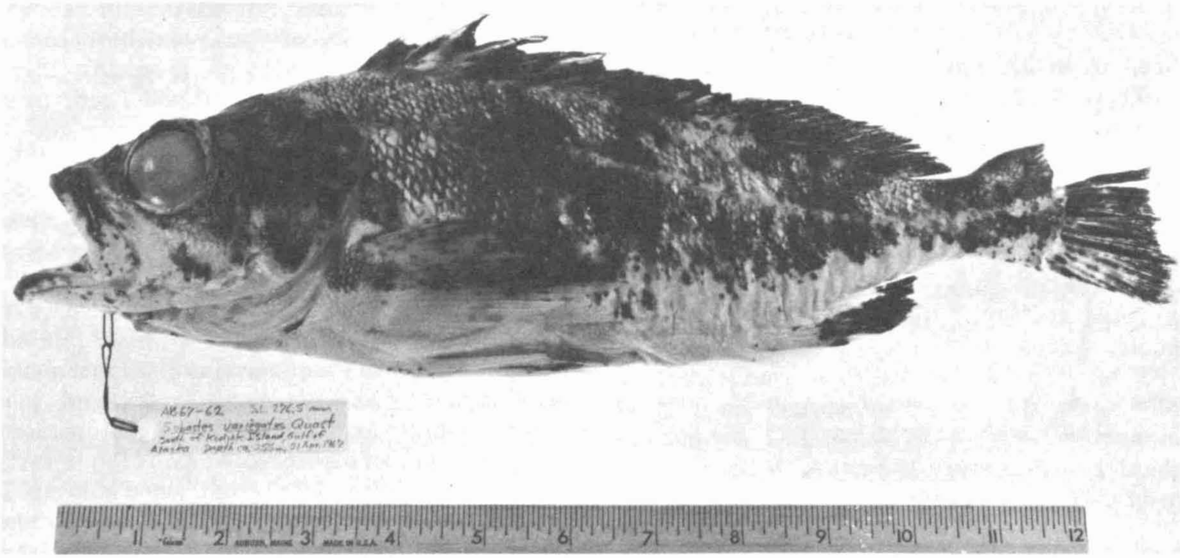

FIGURE 3.—Melanistic specimen of *Sebastes variegatus* (AB 67-62); 277 mm SL; Kodiak Island vicinity.

mm SL), 8 May 1966, *Taiyo Maru No. 2;* AB 67-68 (1, 210 mm SL), 28 April 1967, *Yutaka Maru;* AB 64-847 (1, 153 mm SL), 10 September 1964, *Taiyo Maru No. 77;* AB 68-10 (1, 197 mm SL), 3 September 1964, *Taiyo Maru No. 77;* AB 63-120 (2, 137-143 mm SL), 4 August 1962, RV *Yaquina.* MIDDLE GULF OF ALASKA. Portlock Bank (S of Seward): AB 63-123 (2, 157-230 mm SL), 13 August 1962, RV *Yaquina;* BC 64-292 (1, 223 mm SL), 26 August 1963, *G. B. Reed.* Vicinity of Port Bainbridge (ESE of Seward): AB 64-651 (2, 120-132 mm SL), 16 July 1963, RV *Yaquina.* West of Montague Is.: AB 64-645 (1, 109 mm SL), 16 July 1963, RV *Yaquina.* South of Montague Is.: AB 68-527 (5, 147-169 mm SL), 18 July 1968, RV *Oshoro Maru.* Off Cape Yakataga: AB 68-526 (1, 193 mm SL), 25 July 1968, *Daishin Maru No. 12.* Off Yakutat: AB 70-23 (2, 245-278 mm SL), 15 July 1968, RV *Oshoro Maru.* EASTERN GULF OF ALASKA. Queen Charlotte Sound: BC 70-2 (1, 237 mm SL), 12 June 1970, RV *G. B. Reed* (Electrophaerogram). Frederick Sound: AB 67-11 (3, 241-266 mm SL), 28 February 1967, RV *Murre II.* Forrester Is. vicinity: AB 68-524 (1, 211 mm SL), 24 July 1968, *Ishikari Maru;* AB 68-525 (1, 242 mm SL), 24 July 1968, *Ishikari Maru.* West of Dall Is.: AB 68-24 (3, 146-171 mm SL), 5 November 1956, RV *John N. Cobb.*

DIAGNOSIS

A species of *Sebastes* with body outline slender and symmetrically terete; preocular, postocular, tympannic, and parietal spines present and supraocular, coronal, and (usually) nuchal spines absent; second anal spine longer than third; symphyseal knob not prominent; 18 (rarely 17 or 19) rays in pectoral fin; black spinous dorsal and caudal fin membranes; peritoneum dark brown to jet black; and dark blotched pattern of pigmentation on back and sides, the pattern partly interrupted by a broad unpigmented band that extends over posterior 2/3 of body and includes lateral line.

MORPHOLOGY (PRINCIPALLY FROM HOLOTYPE AND PARATYPES)

Body form, including head, slender, the outline smooth and tapers nearly symmetrically to body axis anteriorly and posteriorly. Body near head flattened laterally, body width slightly greater than 1/2 body depth at pelvic fins. Interorbital region flat to convex. Cranial ridges over orbit usually lower than dorsal profile of head when viewed from side, but sometimes tangent or project slightly above the profile. Dorsal outline of head usually smooth and slightly concave between snout and nape. Lower jaw projects and enters dorsal profile of head. Symphyseal knob weakly developed or absent. Posterior profile of caudal fin indented; that of anal fin slants upward-posteriorly. Pectoral fin symmetrical; both it and pelvic fin extend to or nearly to vent.

Head spines low but strong and well developed—nasal, preocular, postocular, tympannic, and parietal present. Other cranial spines absent except occasionally one nuchal present. Two opercular spines diverge slightly and are contained within outline of opercular flap. Some specimens with one (rarely two) small spines on lower opercle. Two strong suprascapular spines. Five preopercular spines: upper three longest and diverge slightly; second from top longer than either first or third. Lower two preopercular spines broadly triangular and strong. Lacrimal bone has two blunt or rounded prominences ventrally but no spines. Spines absent on suborbital bones and stay.

Spinous rays in dorsal fin strong and sharp, third to fifth usually longest. Interspinous membranes markedly indented posteriorly in each space; indention varies from about 1/2 of length of following spine in first to about 1/4 of following spine in fourth space and posteriorly. Spinous rays of anal and pelvic fins strong and prominent; second anal spine longest, and 14-23% of its length exceeds third. Each soft ray in dorsal fin branched at least once, usually with posterior and sometimes anterior branchlet divided again. Bordering principal rays on caudal fin simple, but branched rays have three sets of dichotomies each (end in eight branchlets). Soft rays of anal fin branched at least once, and usually each branchlet divided again; sometimes posterior branchlet divided several times. Soft rays of pelvic fin branched at least twice, usually with further dichotomies. Uppermost ray of pectoral fin simple; ventrally, degree of branching increases from one dichotomy to 1-1/2 or 2; lowermost rays slightly thickened and simple, rarely with one dichotomy.

Squamation on head ctenoid and nearly complete—includes snout between premaxillary processes (in holotype but not in paratypes), sides of snout, dorsal surface of head, preopercle, opercle, lacrimal area, maxilla, mandible, and branchiostegals. Lips and branchiostegal membranes not scaled. Body fully scaled; scales finely ctenoid on body sides, but ctenation reduced on belly and breast and even more reduced to absent on scales of isthmus, which are all small. A few small, smooth scales extend in line posteriorly from axilla of each pelvic fin. Scales on bases of vertical fins and between pelvic fins markedly reduced in size. Scaled areas on dorsal fin spines extend nearly to tips. Interspinous membranes usually scaled on proximal 1/3; scaled areas usually extend farther distally near fin spines. Dorsal fin squamation mostly smooth on holotype but mostly ctenoid on paratypes. Scales usually absent in areas of dorsal fin membranes with heavy black pigmentation. Rays of soft dorsal fin scaled nearly to tips, but membranes not as completely scaled. Scaled areas of soft dorsal fin usually limited to proximal 2/3 of fin—all scales ctenoid. Squamation of caudal fin ctenoid, its membranes scaled nearly to end of fin. Posterior unpigmented border of fin naked. Caudal rays scaled only near their bases (but scales possibly lost from more distal portions of rays in specimens of this series owing to collection methods). Squamation of anal fin ctenoid; fin spines scaled nearly to tips; interspinous membranes naked except for narrow area bordering third spine. Membranes between anal soft rays scaled over proximal 1/2-3/4; scaled areas extend farther distally on soft rays. Pelvic fin has spines and soft rays scaled nearly to tips; scales mostly smooth. Upper pectoral rays scaled nearly to tips, but squamation absent at unpigmented tips of rays. Proceeding downward on ventral 1/2 of pectoral fin, rays have progressively more naked area distally; extent of naked area progresses from about 1/4 length of uppermost single ray to about 1/2 of lowermost ray.

Upper jaw teeth simple and in two modal sizes. A larger outer row, sometimes mainly uniserial, extends nearly length of each premaxillary. Anteriorly, teeth larger yet and band broadens. A medial gap where tooth patches at lower jaw tip meet upper jaw (small papilla in middle of gap). A smaller inner row of teeth, may also be uniserial, in narrow band over most of premaxillary; it loses uniserial character near large anterior teeth, skirts behind them and continues to medial gap. Teeth of lower jaw simple, uniserial, and similar in size to large teeth in row of upper jaw. Anteriorly, lower jaw teeth are larger and in a tuft that is separated from midline by narrow gap—with jaws shut, from 1/2 to all of each tuft is visible. Vomerine teeth small, in broad V-shaped patch, and sometimes slightly enlarged to suggest a tuft at apex of patch. Palatine teeth small, uniserial except anteriorly where row broadens. Gill rakers slender and pointed, one at bend of arch steps 1.6-2.2 (mode 1.8) into orbit. A small slit behind last gill arch.

A large prenarial pore on side of snout in angle formed by premaxillary process and premaxilla. A larger subnarial pore on flat shelf immediately below nares—outer margin of shelf formed by part of dorsal margin of lacrimal bone. Smaller pores occur singly above nares and below nasal spine. Two large pores on ventral surface of lacrimal bone—one slightly anterior to vertical through subnarial pore and another slightly posterior to this vertical and beneath anterior blunt projection on ventral surface of lacrimal bone. Four prominent pores on each mandible—first in or near fold formed by symphyseal knob and remaining three in a line along ventral surface.

Suborbital bones continuous around eye; second (suborbital stay) conforms to Type 1 of Matsubara (1943a:10-13), i.e. stay tapers to point posteriorly and does not reach preopercle. Sensory canal terminates at midlength of stay. Third and fourth suborbitals tubular. Seven branchiostegals, 5½ on ceratohyal and 1½ on epihyal.

COLOR

Background color of body (based on Kodachrome transparencies of seven freshly caught young adult specimens from Davidson Bank, near Unimak Pass, and the Yakutat vicinity) varies from light pink or light purple-pink to deep red, masked with irregular pattern of dark pigmentation that varies between specimens from barely detectable grey through brown to melanistic black. Masking nearly absent on one large individual with red coloration. Some individuals had faded, nearly colorless appearance. Pattern of black pigmentation on sides below dorsal fin basically three large irregular areas extending from midline to or onto fin. One pigmented area beneath middle and another beneath last 1/4 of spinous dorsal fin—first slightly interrupted by narrow light area where it crosses lateral line; second broadly interrupted by light band reminiscent of band along lateral line of *S. proriger*. Third large pigmented area beneath soft dorsal fin forms irregular circle with light spot at center, continues onto lower 1/2 of soft dorsal fin, interrupted near lower border by broad light-colored band along lateral line. Band extends over posterior 2/3 of body. Small pigmented area on dorsal caudal peduncle extends downward to but not across lateral line and forms anterior boundary of pupil-sized lighter spot on dorsal shoulder of caudal fin. Head with diffuse brown to black shading from symphyseal knob and nearby portions of lower jaw to nape; on snout, shaded area extends ventrally to a line through 7 o'clock position on eye. Behind eye, dark shading extends ventrally to about 5 o'clock position and posteriorly over preopercle. Nape dusky to a line between 1 o'clock position of eye and anterior lateral line. Opercle with two broad pigmented bands whose converging axes meet when projected into lower hemisphere of eye. Upper band includes both opercular spines; lower extends toward pectoral base and includes upper two preopercular spines. Lower band aligns generally with irregular pigmented areas on upper 1/2 of pectoral base. On cheek of most specimens a short pigmented streak extends posteriorly and slightly downward from upper corner of maxilla. Lower cheeks, jaws, and opercular membranes suffused with pink, rose-pink, or red. Spinous dorsal fin with distal 1/2 to 2/3 of interspinous membranes black; remainder above back has pink-related background color of body. Dark pigmentation absent in skin over fin spines, contrasting with dark interspinous membranes. Soft dorsal fin usually distinguished by continuation of body pigmentation onto its lower half where pigmentation forms flattened upper 1/2 of irregular doughnut- or tire-shaped mark. Distally on soft dorsal fin, interspinous membranes darkly pigmented near rays; intervening areas some shade of translucent pink or red. Dark pigmentation terminates equally along fin to form translucent pink border. Caudal fin membranes almost entirely black. Caudal fin terminates with narrow clear or translucent pink or red border. Anal fin pink or red, usually with narrow area or streak of black pigmentation between spines II and III; soft-rayed portion has dusky pigmentation on distal 1/2 of membranes. Background color of pectoral fin same as body but masked by dusky pigmentation in large circular or oval area on upper 2/3 of fin. Small dark pupil-sized spot usually near insertion of rays near midline of fin. Pelvic fin colored as belly.

In preserved specimens dark areas of head, body, and fins persist and include black membranes in spinous dorsal and caudal fins, black stripe between anal spines II and III, dusky pigmentation of lower jaw tip, radiating bands on opercle, black spot in center of pectoral fin, doughnut- or tire-shaped mark below soft dorsal fin, and broad light stripe that accompanies lateral line over posterior 2/3 of body and interrupts two of three large dark areas on body sides. Peritoneum normally dark brown to jet black (one specimen had brown peritoneum with black spots); a melanistic specimen (Figure 3) had light brown peritoneum with black spots).

MERISTIC CHARACTERS

See Table 1.

SIZE OF BODY PARTS

Metrical data on 30 characters are summarized in Tables 2-4. Two methods for fitting regressions of measurements on standard length

TABLE 1.—Counts for meristic characters for holotype of *Sebastes variegatus* and ranges of frequent and infrequent counts for all specimens.

Character	Holotype	Specimens including holotype	
		N	Counts and their frequencies (N)
Precaudal vertebrae	10	3	10
Caudal vertebrae (including urostyle)	17	3	17
Dorsal fin spinous rays	13	38	13(36); 14(2)
Dorsal fin soft rays	14	38	13(1); 14-15(37)
Total rays in dorsal fin	27	38	27-28
Anal fin soft rays	7	38	[1]7
Lower single pectoral rays (2 sides)	8, 9	75	7(3); 8-9(72)
Total pectoral rays (2 sides)	18, 18	75	17(4); 18(70); 19(1)
Pored lateral line scales on body (2 sides)	49, 51	73	42(1); 43-51(71); 52(1)
Pored lateral line scales on caudal fin (2 sides)	1, 1	73	0(1); 1(70); 2(2)
Scale rows below lateral line (2 sides)	58, 58	45	46(1); 47-57(42); 58(2)
Rakers on upper limb	11	38	9(1); 10-12(37)
Rakers on lower limb, including raker at bend	28	38	26-28(37); 29(1)
Total rakers	39	38	36-40(37); 41(1)

[1] One of two additional specimens, examined subsequently, had 6 soft rays in the anal fin.

TABLE 2.—Measurements (mm) of type material, *Sebastes variegatus*.

Character	Holotype (SL = 201)	Paratypes	
		No. 1 (SL = 185)	No. 2 (SL = 193)
Head length	70.0	63.0	64.6
Upper jaw length	32.3	28.8	29.3
Prenarial pore length	1.7	1.0	1.4
Subnarial pore length	2.4	2.5	2.5
Orbit diameter	22.4	18.5	19.0
Interorbital width	14.2	13.4	13.7
Raker length	12.0	10.7	12.0
Lower jaw projection	3.8	3.3	3.6
Snout length	17.5	16.4	17.0
Suborbital width	2.5	2.7	2.2
Head width	30.2	29.5	29.8
Pectoral fin length	60.0	53.1	56.7
Pectoral base length	19.0	18.3	19.2
Caudal peduncle depth	18.0	15.9	16.0
Dorsal caudal peduncle length	28.7	26.0	26.5
Ventral caudal peduncle length	44.3	40.2	40.9
Body depth (pelvic)	58.4	56.5	56.5
Body depth (anal)	47.5	45.2	48.9
Anal spine I length	18.5	16.9	16.5
Anal spine II length	40.2	36.6	37.8
Anal spine III length	33.4	30.9	30.8
Soft dorsal fin base length	52.3	43.7	45.3
Anal fin base length	32.1	27.6	31.0
Pelvic fin spine length	31.7	28.8	30.3
Pelvic fin length	48.0	42.7	44.5
Pelvic insertion to midvent	45.4	46.5	45.6
Midvent to anal fin	11.5	11.0	11.3
Longest dorsal fin spine length	29.8	29.3	28.2
Longest dorsal soft ray length	29.2	26.7	27.2
Longest anal soft ray length	37.9	35.7	35.4

TABLE 3.—Regression of measurements (Y) on SL (X) in the point-slope form of the log-transformed allometric equation $Y = aX^b$ over the interval 109<SLmm<286, *Sebastes variegatus*.

Character (No. specimens)	$\bar{X}$	$\bar{Y}$	$b(\pm 95\%)$[1]	S_{yx}	r^2
Head length (38)	2.26567	1.80164	1.03704(±0.02555)*	0.0100	0.995
Upper jaw (38)	2.26567	1.46445	1.00526(±0.03700)n.s.	0.0100	0.988
Prenarial pore (38)	2.26567	0.12076	0.68961(±0.22125)*	0.4499	0.526
Subnarial pore (38)	2.26567	0.36358	0.64076(±0.15785)*	0.0510	0.653
Orbit (38)	2.26567	1.29809	0.89650(±0.07000)*	0.0224	0.949
Interorbital (38)	2.26567	1.10458	1.17465(±0.05915)*	0.0200	0.978
Raker (37)	2.26051	1.02983	0.99778(±0.09776)n.s.	0.0300	0.926
Lower jaw projection (35)	2.26552	0.59671	1.40000(±0.18610)*	0.0583	0.876
Snout (35)	2.26552	1.20640	1.05453(±0.05560)n.s.	0.0173	0.978
Suborbital (35)	2.26552	0.39634	0.76861(±0.17185)*	0.0539	0.714
Head width (34)	2.27223	1.47624	1.03266(±0.07375)n.s.	0.0224	0.962
Pectoral fin (35)	2.26539	1.71905	0.96682(±0.04611)n.s.	0.0115	0.982
Pectoral base (38)	2.26539	1.24749	0.95907(±0.04845)n.s.	0.0144	0.979
Caudal peduncle depth (35)	2.25292	1.21462	0.93501(±0.05720)*	0.0173	0.971
Dorsal caudal peduncle (35)	2.26552	1.42222	0.98447(±0.06855)n.s.	0.0224	0.962
Ventral caudal peduncle (35)	2.26552	1.59340	0.92085(±0.04905)*	0.0141	0.978
Body depth (pelvic) (38)	2.26567	1.74993	1.01305(±0.06455)n.s.	0.0200	0.966
Body depth (anal) (35)	2.26552	1.66765	0.89023(±0.06100)*	0.0200	0.964
Anal spine I (38)	2.26567	1.20583	0.81995(±0.10465)*	0.0332	0.876
Anal spine II (37)	2.26051	1.54643	0.73519(±0.06340)*	0.0200	0.940
Anal spine III (35)	2.26552	1.46436	0.83416(±0.05255)*	0.0173	0.968
Soft dorsal base (35)	2.26552	1.63887	0.90102(±0.10955)n.s.	0.0346	0.894
Anal base (35)	2.26552	1.46978	0.81406(±0.07225)*	0.0224	0.941
Pelvic fin spine (34)	2.26648	1.45182	0.85218(±0.04725)*	0.0141	0.976
Pelvic fin (38)	2.26567	1.62047	0.93185(±0.03595)*	0.0100	0.987
Pelvic insertion to midvent (38)	2.26567	1.63481	1.15544(±0.11405)*	0.0361	0.922
Midvent to anal fin (35)	2.26552	1.00595	1.10201(±0.25370)n.s.	0.0794	0.703
Longest dorsal fin spine (36)	2.26180	1.40658	0.94004(±0.09285)n.s.	0.0283	0.926
Longest dorsal soft ray (34)	2.26648	1.42402	0.96599(±0.08310)n.s.	0.0265	0.945
Longest anal soft ray (35)	2.26552	1.54610	0.97441(±0.04500)n.s.	0.0141	0.983

[1] Asterisk indicates a difference in the slope exponent (b) significantly different from unity at the 95% level; n.s. indicates no significant difference at this confidence level.

were explored, the power or allometric equation, $Y = aX^b$, in $\log_{10}$ transformed form, and the first degree or rectilinear equation, $Y = a + bX$, untransformed. Both functions were fit by a computer regression program (Sokal and Rohlf, 1969:696). Degree of fit was judged by the "coefficient of percentage variation explained by regression," the square of the correlation coefficient for regression, r^2 (Table 3). In 18 of the 30 characters, nearly identical r^2's were obtained by the alternative equations, including 9 characters for which the allometric exponent differed in a minor (<0.20) but significant degree from unity at the 95% confidence level, i.e. the growth relationships seemed to depart significantly from isometry. Plots of selected examples from the nine characters showed only minor differences between the two functions in these instances. In four comparisons, three of which showed significant departure from unity in the allometric exponent (subnarial pore, lower jaw projection, and suborbital), the first-degree equation appeared to give a superior fit. For the remaining eight comparisons, the allometric equation was superior.

In the light of these considerations, the $\log_{10}$ transformations of the allometric equation ($\log Y = \log a + b \log X$) was chosen for general application because it is more versatile and gave a satisfactory fit in all comparisons. Those few characters which were fit somewhat better by the first-degree equation appear to be of relatively minor utility in rockfish systematics. Parameters are presented in the point-slope form of the transformed allometric equation ($Y = \bar{Y} + b\ (X - \bar{X})$, where $Y = \log_{10} Y$ and $X = \log_{10} X$) to emphasize the working interval about the means of the variates and to de-emphasize the Y-intercept which has no theoretical value in these representations.

The measurements are also presented in the form of 95% confidence limits for proportions of future individual specimens, based on the material examined (Table 4). The limits were

TABLE 4.—Upper and lower 95% confidence limits for single future observations on proportions (percent of SL), based on the material examined.[1]

Character	Standard length (mm)				
	120	160	200	240	280
Head length	35.52	35.84	36.13	36.40	36.64
	32.19	32.59	32.86	33.06	33.22
Upper jaw	16.56	16.56	16.58	16.61	16.64
	15.01	15.06	15.08	15.08	15.08
Prenarial pore	1.16	1.05	0.98	0.93	0.89
	0.58	0.53	0.50	0.47	0.44
Subnarial pore	1.88	1.68	1.55	1.46	1.39
	1.14	1.04	0.96	0.89	0.84
Orbit	12.57	12.16	11.88	11.67	11.52
	10.09	9.83	9.61	9.42	9.25
Interorbital	7.06	7.40	7.70	7.96	8.19
	5.80	6.12	6.37	6.57	6.73
Raker	6.82	6.78	6.78	6.79	6.81
	5.08	5.10	5.10	5.08	5.07
Lower jaw projection	2.41	2.68	2.92	3.16	3.38
	1.35	1.53	1.68	1.80	1.90
Snout	9.29	9.41	9.52	9.63	9.73
	7.83	7.97	8.07	8.14	8.20
Suborbital	1.95	1.81	1.71	1.65	1.60
	1.14	1.08	1.03	0.98	0.94
Head width	17.63	17.71	17.83	17.97	18.11
	14.10	14.30	14.41	14.48	14.51
Pectoral fin length	30.52	30.17	29.95	29.79	29.67
	27.23	27.03	26.83	26.65	26.48
Pectoral base	10.46	10.32	10.22	10.15	10.11
	9.11	9.02	8.94	8.86	8.80
Caudal peduncle depth	10.24	10.02	9.87	9.77	9.70
	8.63	8.49	8.37	8.26	8.16
Dorsal caudal peduncle	16.13	16.00	15.94	15.91	15.91
	12.93	12.92	12.88	12.83	12.76
Ventral caudal peduncle	23.60	23.02	22.61	22.31	22.07
	20.52	20.11	19.76	19.46	19.20
Body depth (pelvic)	33.46	33.48	33.56	33.69	33.83
	27.49	27.68	27.77	27.80	27.80
Body depth (anal)	29.21	28.20	27.51	27.01	26.61
	23.97	23.30	22.75	22.27	21.84
Anal spine I	11.08	10.46	10.05	9.74	9.51
	8.00	7.64	7.34	7.09	6.87
Anal spine II	23.81	21.99	20.72	19.77	19.03
	19.55	18.18	17.14	16.31	15.62
Anal spine III	18.49	17.58	16.93	16.45	16.06
	15.58	14.90	14.36	13.92	13.54
Soft dorsal fin base	29.25	28.26	27.63	27.20	26.89
	20.77	20.31	19.87	19.47	19.11
Anal fin base	21.70	20.39	19.43	18.68	18.07
	13.85	13.24	12.79	12.43	12.14
Pelvic fin spine	17.52	16.75	16.20	15.78	15.45
	15.23	14.63	14.16	13.77	13.44
Pelvic fin length	24.68	24.17	23.80	23.52	23.30
	22.38	21.98	21.65	21.37	21.12
Pelvic insertion to midvent	26.13	27.16	28.11	28.98	29.80
	18.33	19.28	19.97	20.50	20.92
Midvent to anal fin	7.80	7.92	8.09	8.29	8.49
	3.56	3.71	3.80	3.85	3.88
Longest dorsal fin spine	16.46	16.10	15.88	15.74	15.64
	12.45	12.30	12.14	11.98	11.83
Longest dorsal soft ray	16.63	16.39	16.26	16.19	16.15
	12.79	12,73	12.64	12.54	12.44
Longest anal soft ray	20.69	20.49	20.37	20.29	20.24
	17.99	17.90	17.80	17.70	17.61

[1] Based on confidence belts for individual predicted measurements (Sokal and Rohlf, 1969:422) from the parameters for regression (Table 3). Data were back-transformed to arithmetic values for computation of proportions. If limits are desired in the form of measurements, the percentages may be multiplied by the appropriate SL.

obtained from 95% confidence limits for fits to regression (Table 3) back-transformed to the original variates and converted to percent of standard length. Marr (1955) discussed the disadvantages of using proportions in systematics, particularly when size-specific changes are not identified, but neglected several advantages. Size-specific changes are here identified, and the presentation of data in the form of proportions facilitates rapid comparisons between specimens and allows data on measurements to be presented more economically than in graphs. Proportions vary much less with length than original measurements, sometimes surprisingly little when the numerous factors that influence their variation are considered (Table 4), and therefore allow easier interpolation between tabulated reference points than representations of original variates. Also, the continued use of proportions in fish systematics, often without indication of size-specific changes, attests to a prevailing opinion that proportions are useful despite their occasional misuse and other drawbacks.

Plots of the limits for proportions (Table 4) disclose that they are slightly curvilinear and asymmetrical from left to right. These characteristics reflect the y-intercept effect discussed by Marr (1955) combined with the effects of normal divergence of confidence belts in regression with distance from the combined mean, allometry between the original variates, and distortion caused by back-transformation from the logarithm of a function. Size-specific confidence limits for proportions whose allometric coefficients did not differ significantly from unity (Table 3) are included in Table 4 because the calculated value is a better estimate of the exponent than is arbitrarily assumed isometry.

AXIAL SKELETON

X-rays of types show 27 vertebrae, including urostyle (Table 1). Pterygiophores of spinous dorsal fin single in spaces between neural spines except between neural spines 2 and 3, which contains pterygiophores of dorsal fin spines 2 and 3. Pterygiophores of soft dorsal fin usually doubled in interneural spaces except single preceding neural spines 5 and 8 or 9. Caudal skeleton apparently with hypurals 2 and 3 and 4 and 5 fused into upper and lower plates, respectively, as determined for other scorpaenid representatives by Quast (1965:580). Point of enlarged pterygiophore that supports anal fin spines I and II contacts haemal arch of 11th vertebra, here considered the first caudal vertebra.

ELECTROPHORETIC PATTERN

A standardized starch gel electrophaerogram of haemoglobin from a male adult *S. variegatus* (BC 70-2, from Queen Charlotte Sound, British Columbia), with comparative material on *S. zacentrus*, was kindly furnished by Henry Tsuyuki of the Fisheries Research Board of Canada (Figure 4).[3]

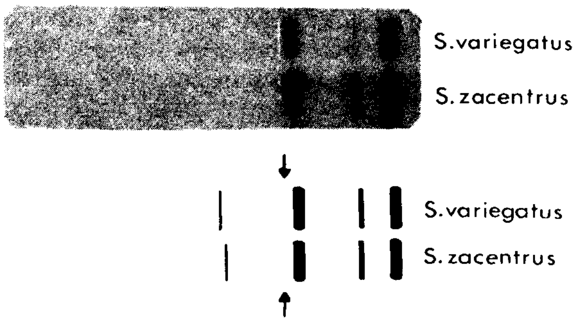

FIGURE 4.—Comparative starch gel electrophaerograms of the haemoglobins from *S. variegatus* and *S. zacentrus* furnished by Henry Tsuyuki, Fisheries Research Board of Canada (see text). The arrow represents the origin in the schematized pattern. The anode is to the right and the cathode to the left. The minor cathodal zone, which Tsuyuki found to be consistently diagnostic for the two species, could not be reproduced photographically and is shown in schematic form in approximately the concentrations found.

[3] Vancouver Laboratory, 6640 NW. Marine Drive, Vancouver 8, British Columbia, 28 July 1970. "Erythrocytes were washed once with a 1% sodium chloride solution before hemolysis to avoid contamination from serum proteins. Haemoglobins from washed and unwashed red cells possessed identical patterns." For methods used in obtaining blood samples and for electrophoresis, see Tsuyuki et al. (1968). Identity of the *S. variegatus* specimen verified by the author; however, the specimen had a head size much larger than normal (38.3% of SL) and was the only specimen out of 40 seen that had 6 soft rays in the anal fin instead of 7.

SIMILAR SPECIES

Sebastes variegatus resembles *S. emphaeus*, *S. proriger*, *S. saxicola*, *S. wilsoni*, and *S. zacentrus* in morphology, morphometry, meristics, and coloration. The six species appear to be closely related members of a complex that generally shares the characters of *S. variegatus* other than the pectoral count of 18, the unpigmented band that encloses the lateral line and extends about 2/3 along the body sides, and the black coloration of the spinous dorsal and caudal fin membranes. The complex may also include *S. dalli*, *S. elongatus*, *S. jordani*, and *S. semicinctus* which also seem to resemble the six species, but these appear to be easier to differentiate from *S. variegatus* and I do not further consider them here. Although the analyses of rockfish haemoglobin and muscle proteins by Tsuyuki et al. (1968) shed little light on the group's validity, subsequent work by Tsuyuki (see footnote 3) suggests a close relationship between *S. variegatus* and *S. zacentrus* (Figure 4). The possibility that *S. variegatus* represents a hybrid may be dismissed because of a normal degree of variation in measurements, distinctiveness and consistency of pectoral ray counts and body coloration, abundance of specimens, and normal reproduction as indicated by normally developed gonads and gravid females.

As a natural group, the six species do not appear to coincide with those at the subgeneric level erected by Cramer, Eigenmann, and Beeson, or Jordan and Evermann, as described by Jordan and Evermann (1898, II: 1765-1777). However, in some respects it does resemble the subgenus *Hatumeus*, erected by Matsubara (1943b: 192) under *Sebastes*, and the type species, *Sebastodes owstoni*, as figured by Jordan and Thompson (1914:pl. 31, fig. 3).

Ranges of meristic characters for most species in the hypothetical group (from Phillips (1957) plus personal examination of representatives—Table 5) either are nearly identical (soft rays in the dorsal, anal, and pectoral fins) or overlap broadly (pored scales in the lateral line, gill rakers, and scale rows below lateral line). In characteristics for which most of the group are nearly identical, *S. variegatus* deviates mark-

TABLE 5.—Data and material for species comparisons with *Sebastes variegatus*.

Species	Phillips (1957)			Material examined		
	No. specimens	Meristics		No. specimens	Meristics	
		No.	SL		No.	SL
S. emphaeus	--	--	--	7	7	101-131
S. proriger	7	6	230-389	12	12	161-270
S. saxicola	35	9	103-308	--	--	--
S. wilsoni	3	3	102-133	6	6	50-174
S. zacentrus	15	10	166-338	20	20	133-281

edly only in pectoral count. In those species where means of characteristics differ noticeably but ranges overlap broadly, *S. variegatus* usually is of central value, which suggests that it may be a more generalized member of the group.

Comparisons of morphometric characters between *S. variegatus* and the other species lead to a similar conclusion. Ranges for the species overlap broadly, based on Phillips (1957) and my own measurements (head length, longest dorsal fin spine, least depth of caudal peduncle, pelvic insertion to vent, raker at bend of gill arch, width of pectoral fin base, body depth at pelvic girdle, bony interorbital, orbit, length of pectoral fin, length of pelvic fin, and length of upper jaw—in percent of standard length).

To assist differentiating *S. variegatus* from similar species a table of discriminatory characters is presented (Table 6).

GEOGRAPHIC AND BATHYMETRIC RANGE

Present known range of *S. variegatus* is from Unimak Pass, Aleutian Islands, to Goose Island Bank, Queen Charlotte Sound[4] (Figure 5). Depth of capture ranges from 70 to 305 m.

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[4] The record for Queen Charlotte Sound was obtained by Sigurd J. Westrheim, Fisheries Research Board of Canada, Nanaimo Research Station, Nanaimo, British Columbia, on the RV *G. B. Reed* during Cruise GBR 70-1 (personal communication, 5 August 1970).

TABLE 6.—Summary of salient comparative features of *Sebastes variegatus* with five similar speces. (Proportions of *S. variegatus* refer to 95% confidence limits of Table 4. Source and quantity of data on other species are summarized in Table 5. Code for sources: *, Phillips (1957); **, original material (Tables 1-4); ***, both sources. In some instances my data on northeastern Pacific specimens differ from Phillips (1957) in degree of discrimination.)

S. emphaeus.
Counts: Pectoral rays 17 (occas. 18)**, *variegatus* 18 (occas. 17); scale rows ≤46*, *variegatus* ≥46. Percent of SL (apply to interval of size overlap, 109-131 mm): Upper jaw ≤15.0**, *variegatus* ≥15.0; ventral caudal peduncle ≤20.8**, *variegatus* ≥20.5; anal spine I ≤8.3**, *variegatus* ≥8.0; anal spine II ≤19.4**, *variegatus* ≥19.6; anal spine III ≤15.8**, *variegatus* ≥15.6. Pigmentation: Blotches on sides not interrupted by an unpigmented band along lateral line; no black area on fin membrane between anal spines II and III (both characteristics from pl. 31 of Starks, 1911).

S. proriger.
Counts: Pectoral rays 17*** (occas. 18)**, *variegatus* 18 (occas. 17); scale rows ≥55* (47-56)**, *variegatus* ≤58. Percent of SL (apply to interval of size overlap 161-270 mm, for Quast data): Upper jaw ≤14.7* (≤15.7)**, *variegatus* ≥15.1; orbit ≤9.3* (≤10.5)**, *variegatus* ≥9.3; anal spine II ≤15.4* (≤16.4 but normally below 95% limits of *variegatus* at size [Table 4])**; anal spine III (below 95% limits of *variegatus* at size [Table 4])**; pelvic fin (below 95% limits of *variegatus* at size [Table 4])**, longest dorsal soft ray ≤12.5*, *variegatus* ≥12.4; longest anal soft ray ≤16.1*, *variegatus* ≥17.6. Pigmentation: Unpigmented band along lateral line extends to head.

S. saxicola.
Counts: Dorsal soft rays 12 (occas. 13)*, *variegatus* 14 or 15 (occas. 13); pectoral rays 16 (occas. 15 or 17)*, *variegatus* 18 (occas. 17); lateral line pored scales ≤42*, *variegatus* ≥42; rakers ≤34*, *variegatus* ≥36. Percent of SL: head ≥35.7*, *variegatus* ≤36.6; orbit ≥11.8*, *variegatus* ≤12.5; longest anal soft ray ≤18.2*, *variegatus* ≥17.6. Pigmentation: Blotches on sides not interrupted by unpigmented band along lateral line.

S. wilsoni.
Counts: Anal scft rays 6***,*variegatus* 7 (rarely 6); pectoral rays 16-17* (occas. 18)**, *variegatus* 18 (occas. 17); lateral line pored scales ≤41* (≤43)**, *variegatus* ≥42; scale rows 45-50* (41-45)**, *variegatus* ≥46. Percent of SL (apply to interval of size overlap, 109-174 mm, in Quast data): pelvic fin length ≤22.0**, *variegatus* ≥22.0. Pigmentation: Dark blotches on sides not interrupted by an unpigmented band along lateral line.

S. zacentrus.
Counts: Pectoral rays 17 (occas. 18)*, (occas. 19)**, *variegatus* 18 (rarely 17 or 19)**; scale rows 43-50* (≤47)**, *variegatus* ≥46; rakers ≤37* (≤38)**, *variegatus* ≥36. Percent of SL (apply to interval of size overlap, 133-281, for Quast data): Upper jaw 15.6-16.9* (normally above 95% limits of *variegatus* at size [Table 4])**; longest anal soft ray ≤17.9*, *variegatus* ≥17.6. Pigmentation: Blotchts on sides not interrupted by unpigmented band along lateral line.

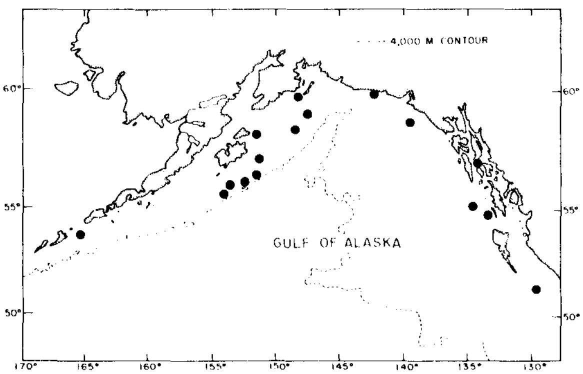

FIGURE 5.—Localities at which *Sebastes variegatus* were captured.

Sigurd J. Westrheim (Fisheries Research Board of Canada, Nanaimo Research Station) furnished fresh material and reviewed the manuscript, and Henry Tsuyuki (Fisheries Research Board of Canada, Vancouver Laboratory) contributed the haemoglobin electrophaerograms. Daniel M. Cohen (United States National Museum), William N. Eschmeyer (California Academy of Sciences), and Bruce L. Wing (National Marine Fisheries Service Biological Laboratory, Auke Bay, Alaska) provided editorial and scientific comments.

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