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## THE SUPPOSED INTERGRADATION OF THE TWO SPECIES OF *SEBASTOLOBUS* (A GENUS OF SCORPÆNOID FISHES) OF WESTERN AMERICA

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For years I have been fascinated with the problem of the relationships of intergrading forms. It was therefore with much interest that I read the recent discussion by Townsend and Nichols<sup>1</sup> of the intergradation off the California Coast of the two species of the scorpenoid genus *Sebastolobus*, namely *S. alascanus* Bean and *S. altivelis* Gilbert, of western America.

Their view of the situation was apparently as follows. *Sebastolobus alascanus* inhabits the shallower water in Alaska but the deeper water off southern California (as though the depth distribution were isothermal). Where their habitats criss-cross off central California, the two forms intergrade, intermediates being the rule. "South of Pt. Conception off the Sta. Barbara Islands (latitude 33°) we find *alascanus* (described from Alaska in 159 fathoms) at 640 fathoms, intermediates at 534 fathoms, *altivelis* (described from Alaska in 625 fathoms) at 451 fathoms."

In response to a suggestion that the problem should be restudied, Mr. Nichols kindly has had sent to me nearly all of the material on which the conclusions cited were based. On examining these specimens in the light of Gilbert's critical comparison (1915, pp. 328-330) of the two forms (which discussion Townsend and Nichols did not use or quote), it now becomes evident that all of Townsend and Nichols' material of *Sebastolobus*, including that part identified as *S. alascanus*, is referable to *S. altivelis*.

In all their series, including the lot from 'Albatross' Station 5694, identified wrongly as *alascanus*, the dorsal spines are more frequently 15 than 16, and show a range of variation from 14 to 16 rather than from 15 to 17 as in *alascanus*, in which species the spines are most frequently 16 in number; the third dorsal spine, rather than the fourth or fifth, is the highest; although variable in height, even in one set of specimens, being contained

<sup>1</sup>Townsend and Nichols, 1925, pp. 13-14. Incidentally, attention may be drawn to the fact that the hagfish described on page 4 of the same report as *Polistotrema curtiss-jamesi* seems to be identical with *P. deani* Evermann and Goldsborough, 1907, p. 225, fig. 1, a species described from Alaska.

1.7 to 3.0 times in head, this spine is higher than the highest in *alascanus* (2.9 to 3.5 in head), and much higher than the third spine in that species; furthermore, the emargination of the dorsal fin is not so deep nor extensive as in *alascanus*. In all of the specimens, including those called *alascanus* by Townsend and Nichols, the spination of the head shows the characters of *altivelis*; the anterior paroccipital is represented, when developed at all, only by one to three small points, rather than by the definite spine characteristic of the true *alascanus*. In all the lots, including that from Station 5694, the gill-rakers are better developed than in *alascanus*, being somewhat more than half as long as the pupil, and 21 to 24 in total number on the first arch, instead of 18 to 22 (rudiments counted). In all of the series the coloration is entirely characteristic of *altivelis* rather than *alascanus*, and the specimens from several stations, including those from Station 5694, identified by Townsend and Nichols as *alascanus*, exhibit the age changes in coloration which Gilbert has described in detail for *altivelis*; none of the specimens show the light vertical lines or rows of spots across the dark pectoral blotch—one of the striking features of *alascanus*.

From a study of the material identified by Townsend and Nichols as *Sebastolobus alascanus* and *altivelis*, I conclude that but one species, *altivelis*, is represented, and therefore that the conclusions of these authors in regard to the intergradation of these forms are unwarranted by the facts in the case.

Having misidentified their material, Townsend and Nichols were led into an erroneous idea of the depth distribution of these two species of *Sebastolobus*. In neither case is there evident any relation between latitudinal and bathymetric distribution. In southern California as elsewhere *altivelis* generally inhabits deeper water than does *alascanus* (not shallower, as Townsend and Nichols thought). Throughout the range of the two species, the great majority of the depth records for *altivelis* lie between 300 and 700 fathoms, with shallow extremes at 110–199 and 130–149 fathoms and deep extremes at 822 and at 755–847 fathoms. Most of the depths recorded for *alascanus*, on the other hand, are between 100 and 300 fathoms, with an extreme range extending from 10 to 822 fathoms. The two species thus overlap widely in their depth distribution, and both have not infrequently been brought up in the same dredge haul. The available data are summarized in Table 1, and listed in greater detail in Table 2.

Correlated with the fact that it usually occurs in shallower water, *alascanus* lives in the average in warmer water than does *altivelis*, most frequently at temperatures of 40° to 46° F., rather than 38° to 40°.

In Table 2 there are listed all published<sup>1</sup> and original records of *Sebastolobus alascanus* and *S. altivelis*, arranged according to latitude. Depth and bottom-temperature determinations are included whenever published. The latitude is given to the nearest minute; in many cases the latitude was approximately determined from the shore bearings given in the 'Albatross' records. The depth records given in Table 2 are summarized in Table 1. Each depth record is usually entered but once in the summary, but occasionally twice or even thrice. The depth record (389-551 fathoms) for 'Albatross' Station 4540, for example, is listed under the depths 300-399, 400-499 and 500-599 fathoms. Records preceded by an asterisk have been verified by a re-examination of the material involved. Thanks are due the authorities of the American and National Museums for the privilege of examining the material of *Sebastolobus* in their possession.

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<sup>1</sup>With the exception of the records given by Fowler (1923, p. 298), these being eliminated because the authorities of the Scripps Institution inform me that the data on these specimens have been confused and are not trustworthy.

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TABLE I. SUMMARY OF THE DEPTH RECORDS

A frequency table summarizing all published and original depth records of the two North American species of *Sebastolobus* at different latitudes.

Species	<i>Sebastolobus alascanus</i>					<i>Sebastolobus altivelis</i>				
	Southern Alaska and British Columbia	Washington and northern Oregon	Central California	California south of Pt. Conception	Entire range of <i>alascanus</i>	Southern Alaska and British Columbia	Washington and northern Oregon	Central California	California south of Pt. Conception	Near Cape San Lucas
Latitude	60°-50°	49°-45°	40°-35°	34°-32°	Totals	60°-50°	49°-45°	40°-35°	34°-32°	28°-22°
10-99	...	...	4	2	6	...	...	...	...	...
100-199	6	1	6	3	16	...	...	1	1	...
200-299	11	...	10	8	29	...	...	1	3	...
300-399	2	1	1	4	8	...	...	5	4	...
400-499	2	...	2	3	7	...	...	5	7	...
500-599	...	1	...	...	1	...	1	3	5	...
600-699	2	...	...	...	2	1	...	2	3	1
700-799	...	1	...	...	1	...	...	2	1	...
800-847	...	...	...	1	1	...	...	1	1	...
Depth in fathoms	Totals					Totals				
	...	...	...	...	6	...	...	...	...	...
	...	...	...	...	16	...	...	...	...	...
	...	...	...	...	29	...	...	...	...	...
	...	...	...	...	8	...	...	...	...	...
	...	...	...	...	7	...	...	...	...	...
	...	...	...	...	12	...	1	...	...	...
	...	...	...	...	9	...	...	...	...	...
	...	...	...	...	7	1	...	...	...	...
	...	...	...	...	3	...	...	...	...	...
	...	...	...	...	2	...	...	...	...	...

TABLE 2. RECORDS FOR *Sebastolobus alascanus* AND *Sebastolobus altivelis*

Approximate latitude	'Albatross' Station	Depth in fathoms <i>alascanus</i>	Depth in fathoms <i>altivelis</i>	Bottom temperature <i>alascanus</i>	Bottom temperature <i>altivelis</i>	Literature record, etc.
*58° 17'	2858	230	.....	39.8	.....	Evermann and Goldsborough, 1907, p. 279.
*56° 14'	4302	169-212	.....	44.2	.....	Bean, 1890, p. 44.
*56° 00'	2853	159	.....	41.0	.....	Evermann and Goldsborough, 1907, p. 279.
*55° 52'	4236	147-205	.....	42.8	.....	Evermann and Goldsborough, 1907, p. 279.
55° 49'	4238	229-231	.....	42.5	.....	Evermann and Goldsborough, 1907, p. 279.
*55° 29'	4239	206-248	.....	48.8	.....	Evermann and Goldsborough, 1907, p. 279.
*55° 29'	4240	248-256	.....	48.8	.....	Evermann and Goldsborough, 1907, p. 279.
*55° 27'	4241	238-245	.....	49.3	.....	Evermann and Goldsborough, 1907, p. 279.
55° 26'	3340	695	.....	36.8	.....	Gilbert, 1896, p. 409.
54° 46'	3339	138	.....	37.4	.....	" " " "
54° 36'	3227	225	.....	38.6	.....	" " " "
54° 19'	3338	625	625	37.3	37.3	" " pp. 409, 410.
54° 03'	3332	406	.....	.....	.....	" " p. 409.
54° 02'	3331	350	.....	.....	.....	" " " "
54° 01'	3330	351	.....	37.8	.....	" " " "
*53° 55'	3337	280	.....	39.3	.....	" " " "
53° 34'	3324	109	.....	.....	.....	" " " "
52° 56'	4784	135	.....	.....	.....	" " " "
52° 14'	4781	482	.....	.....	.....	" " " "
*51° 14'	2861	204	.....	42.6	.....	" and Burke, 1912, p. 35.
*50° 49'	2862	238	.....	44.7	.....	" " " "

TABLE 2. RECORDS FOR *Sebastolobus alascanus* AND *Sebastolobus altivelis*—(continued)

Approximate latitude	Albatross' Station		Depth in fathoms		Bottom temperature <i>alascanus</i>	Bottom temperature <i>altivelis</i>	Literature record, etc.
	<i>alascanus</i>	<i>altivelis</i>	<i>alascanus</i>	<i>altivelis</i>			
*48° 09'	2866	.....	171	.....	43.2	.....	Gilbert, 1896, p. 409. (Albatross, N. W. of West Pt. of Elliot Bay, Puget Sound).
47° 41'	3343	.....	516	.....	38.2	.....	
ca. 47° 20'	.....	.....	.....	.....	.....	.....	
*46° 55'	2871	.....	.....	559	.....	38.4	Gilbert, 1896, p. 409. " " " " " " " " " " " " (Collected by Hubbs; data ap- proximate).
45° 30'	3346	.....	786	.....	37.3	.....	
45° 10'	3347	.....	345	.....	40.9	.....	
39° 03'	3348	.....	455	.....	47.6	.....	
38° 17'	3170	.....	167	.....	.....	.....	
*37° 50'	.....	.....	250	.....	.....	.....	
37° 49'	3161	.....	191	.....	44.5	.....	Gilbert, 1896, p. 468. "
*37° 37'	4565	.....	.....	495-587	.....	.....	
*37° 28'	3479	.....	276	.....	.....	.....	
*37° 23'	3104	.....	.....	391	.....	40.8	
37° 08'	3112	.....	296	296	41.8	41.8	
37° 01'	3208	.....	203	.....	44.3	.....	
36° 55'	3204	.....	202	.....	44.1	.....	
36° 49'	3126	.....	456	.....	.....	.....	
*36° 47'	4510	.....	91-156	.....	.....	.....	
*36° 47'	4522	.....	130-149	130-149	.....	.....	
*36° 47'	4462	.....	161-265	.....	44.4	.....	
*36° 46'	4475	.....	58-85	.....	.....	.....	
*36° 46'	4509	.....	152-286	.....	.....	.....	
36° 46'	3202	.....	.....	382	.....	41.1	
*36° 46'	4540	.....	.....	389-551	.....	.....	

TABLE 2. RECORDS FOR *Sebastes lobus alascanus* AND *Sebastes lobus atlavicus*—(continued)

Approximate latitude	'Albatross' Station	Depth in fathoms		Bottom temperature <i>atlavicus</i>	Bottom temperature <i>alascanus</i>	Literature record, etc.
		<i>alascanus</i>	<i>atlavicus</i>			
*36° 45'	3666	68	.....	.....	.....	Gilbert, 1899, " 25.
*36° 45'	3667	90	.....	.....	47.7	" " " "
36° 45'	3127	.....	418	.....	.....	" 1896, " 468.
*36° 43'	4542	.....	331-456	.....	.....	" 1915, " 330.
36° 43'	3670	.....	581	.....	.....	" 1899, " 26.
*36° 43'	4517	.....	750-766	.....	.....	" 1915, " 330.
36° 42'	3128	.....	627	.....	.....	" 1896, " 468.
*36° 39'	4530	.....	755-847	.....	.....	" 1915, " 330.
36° 19'	3186	328	.....	.....	41.3	" 1896, " 468.
36° 14'	3187	298	.....	.....	41.1	" " " "
36° 08'	3188	.....	316	.....	.....	" " " "
*36° 00'	5699	.....	659	.....	.....	Townsend and Nichols, 1925, p. 13.
*35° 50'	5698	.....	475	.....	.....	Townsend and Nichols, 1925, p. 13.
*35° 35'	3191	211	.....	.....	44.0	Gilbert, 1896, p. 468.
*35° 35'	5697	.....	485	.....	.....	Townsend and Nichols, 1925, p. 13.
*35° 18'	5696	.....	440	.....	.....	Townsend and Nichols, 1925, p. 13.
35° 14'	3195	252	.....	.....	.....	Gilbert, 1896, p. 468.
*35° 03'	3196	200	.....	.....	43.2	Townsend and Nichols, 1925, p. 13.
34° 17'	3199	233	.....	.....	44.1	Townsend and Nichols, 1925, p. 13.
*34° 15'	2892	284	.....	.....	43.9	Gilbert, 1896, p. 468.
*34° 11'	2960	267	.....	.....	44.1	" " " "
33° 55'	2948	266	.....	.....	48.0	" " " "
*33° 55'	2896	376	.....	.....	.....	" " " "
*33° 33'	5695	.....	376	.....	.....	" " " "
33° 29'	4412	265-274	534	.....	.....	Townsend and Nichols, 1925, p. 13.
*33° 25'	4410	178-195	265-274	.....	.....	Gilbert, 1915, pp. 328-330.
			.....	.....	.....	" " " " p. 328.



TABLE 2. RECORDS FOR *Sebastolobus alascanus* and *Sebastolobus altivelis*—(continued)

Approximate latitude	'Albatross' Station	Depth in fathoms		Bottom temperature		Literature record, etc.
		<i>alascanus</i>	<i>altivelis</i>	<i>alascanus</i>	<i>altivelis</i>	
*33° 25'	5694	.....	640	.....	.....	Townsend and Nichols, 1925, p. 13.
33° 21'	.....	10-15	.....	.....	.....	Gilbert, 1899, p. 25.
*33° 13'	5693	.....	451	.....	.....	Townsend and Nichols, 1925, p. 13.
*33° 11'	4421	229-298	229-298	.....	.....	Gilbert, 1915, pp. 328, 330.
*33° 00'	4402	.....	542-599	.....	40.0	" " p. 330.
*32° 54'	4322	110-199	110-199	45.4	45.4	" " pp. 328, 330.
*32° 53'	4401	.....	448-468	.....	40.0	" " p. 330.
*32° 50'	4400	.....	500-507	.....	40.2	" " "
*32° 49'	2936	359	359	49.0	49.0	
*32° 47'	2928	417	.....	41.0	.....	
*32° 45'	4399	264-285	.....	.....	.....	Gilbert, 1915, p. 330.
*32° 44'	3627	.....	776	.....	.....	
*32° 41'	4366	176-181	.....	46.0	.....	Gilbert, 1915, p. 328.
32° to 33°	.....	.....	413	.....	.....	Starks and Mann, 1911, p. 11.
*32° 40'	2923	822	822	39.0	39.0	
*32° 32'	2925	339	339	42.9	42.9	
*32° 31'	4306	207-497	.....	40.2	.....	
*32° 30'	4307	490-496	490-496	40.3	40.3	Gilbert, 1915, p. 328.
*32° 30'	4351	.....	423-488	.....	40.0	" " pp. 328, 330.
*32° 30'	4317	.....	471-510	.....	.....	" " p. 330.
*32° 30'	4353	.....	628-640	.....	39.0	" " "
*32° 29'	4333	.....	301-487	.....	40.1-41.7	" " "
*32° 28'	4336	.....	518-565	.....	39.0	" " "
*32° 27'	2929	.....	623	.....	.....	
22° 47'	5683	.....	630	.....	39.1	Townsend and Nichols, 1925, p. 13.

