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THE LATITUDINAL VARIATION IN THE  
NUMBER OF VERTICAL FIN-RAYS  
IN *LEPTOCOTTUS ARMATUS*

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## I

It has frequently been noted that the number of vertebrae and related characters of fishes, the fin-rays included, increase from tropical waters toward the poles—a problem now being investigated from several angles by the present writer. This short paper is presented as an addition to the data bearing on the phenomenon.

It has already been observed by Nichols<sup>1</sup> and by Starks (MS) that the dorsal and anal rays of *Leptocottus armatus* tend to increase in number toward the north, but neither of these ichthyologists possessed sufficient material from the critical region of the south-central coast of California; a deficiency overcome by the writer, who collected extensively in this region in 1916. The sharpest break in the series occurs in central California, enabling the distinction of a southern comparatively few-rayed subspecies from a northern many-rayed form; this break conforms with a like

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<sup>1</sup> *Proc. Biol. Soc. Wash.*, XXI (1908), 172.

division of other elements of the fauna of western North America. Additional material will probably permit the separation of an Alaskan subspecies.

But whatever systematic treatment we may decide to accord these forms, it appears demonstrated that the fin-rays increase gradually in number northward, being fewest in the warm bays of southern California and most numerous along the colder coast of Alaska. Other similar cases will be recorded by the writer.

## II

The following two tables illustrate this northward increase in the number of dorsal and anal fin-rays in *Leptocottus armatus*. The last ray in each fin is counted as branched; this ray having obviously been listed as two by Nichols, his counts are all decreased by one.

TABLE I

GEOGRAPHICAL VARIATION IN NUMBER OF RAYS OF SECOND DORSAL FIN IN  
*Leptocottus armatus*

Locality	Subspecies	Second Dorsal Rays						Authority	
		14	15	16	17	18	19		
Port Mulgrave, Alaska.....	<i>armatus</i>	..	..	..	1	..	..	Nichols	
Seward, Alaska.....	<i>armatus</i>	..	..	..	..	4	3	Nichols	
Karluk, Alaska.....	<i>armatus</i>	..	..	..	..	1	..	Hubbs	
Juneau, Alaska.....	<i>armatus</i>	..	..	..	2	..	..	Hubbs	
Sitka, Alaska.....	<i>armatus</i>	..	..	..	..	1	4	1	Nichols
Snug Harbor, Alaska.....	<i>armatus</i>	..	..	..	..	1	..	..	Nichols
Hunter Bay, Alaska.....	<i>armatus</i>	..	..	..	..	1	..	1	Nichols
Gabriola Id., British Columbia.....	<i>armatus</i>	..	..	..	..	2	..	..	Nichols.
Barclay Sound, British Columbia.....	<i>armatus</i>	..	..	..	..	1	..	..	Nichols
Nanaimo, British Columbia.....	<i>armatus</i>	..	..	..	..	..	1	..	Hubbs
San Juan Is., Washington...	<i>armatus</i>	..	..	..	2	7	..	..	Hubbs
Port Townsend, Washington.....	<i>armatus</i>	..	..	..	..	1	..	..	Nichols
Seattle, Washington.....	<i>armatus</i>	..	..	..	2	1	..	..	Hubbs
Cape Flattery, Washington.....	<i>armatus</i>	..	..	..	..	1	..	..	Hubbs
Florence, Oregon.....	<i>armatus</i>	..	..	..	..	1	..	..	Hubbs
Glenada, Oregon.....	<i>armatus</i>	..	..	1	5	4	1	..	Nichols
San Francisco market.....	<i>armatus</i>	..	..	..	3	2	..	..	Hubbs
San Francisco Bay.....	<i>armatus</i>	..	..	..	6	1	..	..	Hubbs
Santa Cruz, California.....	<i>armatus</i>	..	..	1	7	2	..	..	Hubbs
Carmel River, California....	?	..	..	1	..	..	..	..	Hubbs
Morro Creek, California....	<i>australis</i>	..	..	5	1	..	..	..	Hubbs
Morro Bay, California.....	<i>australis</i>	..	6	15	3	..	..	..	Hubbs
Chorro Creek, California....	<i>australis</i>	..	1	..	..	..	..	..	Hubbs
Avila, California.....	<i>australis</i>	..	1	1	..	..	..	..	Hubbs
Santa Inez River, California.....	<i>australis</i>	..	2	6	2	..	..	..	Hubbs
Goleta, California.....	<i>australis</i>	..	1	4	1	..	..	..	Hubbs
Santa Barbara, California....	<i>australis</i>	..	..	1	..	..	..	..	Hubbs
Carpenteria, California.....	<i>australis</i>	..	10	26	6	..	..	..	Hubbs
Ventura, California.....	<i>australis</i>	1	..	4	1	..	..	..	Hubbs
Mission Bay, California.....	<i>australis</i>	..	4	4	..	..	..	..	Hubbs
San Diego Bay, California.....	<i>australis</i>	..	9	12	..	..	..	..	Nichols; Hubbs
All localities.....	<i>armatus</i>	..	..	2	29	32	7	..	..
All localities.....	<i>australis</i>	1	34	78	14	..	..	..	..

TABLE II  
GEOGRAPHICAL VARIATION IN NUMBER OF ANAL RAYS IN  
*Leptocottus armatus*

Locality	Subspecies	Anal Rays					Authority	
		14	15	16	17	18		19
Port Mulgrave, Alaska.....	<i>armatus</i>	..	..	1	..	..	..	Nichols
Seward, Alaska.....	<i>armatus</i>	..	..	..	3	3	1	Nichols
Karluk, Alaska.....	<i>armatus</i>	..	..	1	..	..	..	Hubbs
Sitka, Alaska.....	<i>armatus</i>	..	..	?	2	3	..	Nichols
Snug Harbor, Alaska.....	<i>armatus</i>	..	..	..	1	..	..	Nichols
Hunter Bay, Alaska.....	<i>armatus</i>	..	..	..	2	..	..	Nichols
Gabriola Id., British Columbia.....	<i>armatus</i>	..	..	..	1	1	..	Nichols
Barclay Sound, British Columbia.....	<i>armatus</i>	..	..	..	1	..	..	Nichols
Nanaimo, British Columbia.....	<i>armatus</i>	..	..	..	..	1	..	Hubbs
San Juan Is., Washington...	<i>armatus</i>	..	1	4	4	..	..	Hubbs
Port Townsend, Washington.....	<i>armatus</i>	..	..	..	1	..	..	Nichols
Seattle, Washington.....	<i>armatus</i>	..	..	2	1	..	..	Hubbs
Cape Flattery, Washington.....	<i>armatus</i>	..	..	..	1	..	..	Hubbs
Florence, Oregon.....	<i>armatus</i>	..	..	1	..	..	..	Hubbs
Glenada, Oregon.....	<i>armatus</i>	..	..	6	5	..	..	Nichols
San Francisco market.....	<i>armatus</i>	..	..	3	2	..	..	Hubbs
San Francisco Bay.....	<i>armatus</i>	..	..	6	1	..	..	Hubbs
Santa Cruz, California.....	<i>armatus</i>	1	3	6	..	..	..	Hubbs
Carmel River, California....	?	..	..	1	..	..	..	Hubbs
Morro Creek, California....	<i>australis</i>	2	2	2	..	..	..	Hubbs
Morro Bay, California.....	<i>australis</i>	2	14	7	..	..	..	Hubbs
Chorro Creek, California....	<i>australis</i>	..	1	..	..	..	..	Hubbs
Avila, California.....	<i>australis</i>	..	2	..	..	..	..	Hubbs
Santa Inez River, California.....	<i>australis</i>	1	7	2	..	..	..	Hubbs
Goleta, California.....	<i>australis</i>	1	5	..	..	..	..	Hubbs
Santa Barbara, California....	<i>australis</i>	..	1	..	..	..	..	Hubbs
Carpenteria, California.....	<i>australis</i>	10	26	6	..	..	..	Hubbs
Ventura, California.....	<i>australis</i>	2	3	1	..	..	..	Hubbs
Mission Bay, California....	<i>australis</i>	..	8	..	..	..	..	Hubbs
San Diego Bay, California.....	<i>australis</i>	9	12	..	..	..	..	Nichols; Hubbs
All localities.....	<i>armatus</i>	1	4	31	25	7	1	.....
All localities.....	<i>australis</i>	27	81	18	..	..	..	.....

## III

**Leptocottus armatus australis**, new subspecies

*Leptocottus armatus* Girard, *Proc. Acad. Nat. Sci. Phila.*, VII (1854), 145 (in part; not type); *U.S. Pac. R.R. Surv.*, X, part 4 (1858), 60, Pl. 15, Fig. 2 (in part); Jordan and Gilbert, *Proc. U.S. Nat. Mus.*, III (1880), 25, 455 (in part); *ibid.*, IV (1881), 60; *Bull. U.S. Nat. Mus.*, XVI (1883), 713 (in part); Rosa Smith, *Proc. U.S. Nat. Mus.*, VI (1883), 235; *West Am. Sci.*, I (1885), 46; Eigenmann, *Proc. U.S. Nat. Mus.*, XV (1892), 131, 168; Eigenmann and Eigenmann, *Ann. N.Y. Acad. Sci.*, VI (1892), 356 (in part); Jordan and Evermann, *Bull. U.S. Nat. Mus.*, XLVII, part 2 (1898), 2012; Part 4 (1900), Pl. 302, Fig. 733 (in part); Starks and Morris, *Publ. Zool. Univ. Cal.*, III (1907), 220 (in part); Nichols, *Proc. Biol. Soc. Wash.*, XXI (1908), 172 (in part).

*Holotype*: A specimen 87 mm. long to caudal base, seined by the writer in the brackish water lagoon at the mouth of Ventura River, at Ventura, California, on June 27, 1916; Cat. No. 55055; Museum of Zoology, University of Michigan.

*Diagnosis*: Like typical *armatus*, but with fewer rays in the vertical fins; dorsal spines 6 or 7 instead of 7 or 8 (usually 7 in each subspecies); dorsal soft rays 14 to 17 (usually 16), instead of 16 to 19 (usually 17 or 18); anal rays 14 to 16 (usually 15) rather than 15 to 19 (usually 16 or 17), the last soft ray in all cases counted as double. The variation in the number of rays in the second dorsal and anal fins in the various parts of the range of the species is indicated in the preceding tables.

*Record-stations*: *Leptocottus armatus australis* has been recorded or taken by the writer at the following localities, all in California:

San Luis Obispo County: fresh tidewater of Morro Creek (Hubbs); sand bar in Morro Bay, at mouth of Morro Creek (Hubbs); fresh tidewater of Chorro Creek (Hubbs); Avila, in brackish lagoon at mouth of San Luis Creek (Hubbs); "San Luis Obispo" (Jordan and Gilbert).

Santa Barbara County: slightly brackish lagoon at mouth of Santa Inez River, at Surf (Hubbs); near mouth of *estero* at Goleta

(Hubbs); Santa Barbara (Jordan and Gilbert); El Estero at Carpenteria (Hubbs).

Ventura County: brackish lagoon at Ventura, at the mouth of Ventura River (Hubbs).

Los Angeles County: San Pedro Bay (Girard; Jordan and Gilbert).

Orange County: sloughs of Alamitos Bay (Hubbs).

San Diego County: inclosed salt water lagoon at mouth of San Diequito River, near Del Mar (Hubbs); Mission Bay, also known as False Bay (collected by Scripps Institution for Biological Research); San Diego Bay (Girard and later authors; young collected by the writer in the sloughs of Dutch Flats on March 14, 1913).

Lower California: small stream near mouth, near Rosario, just south of the international boundary (Rosa Smith).

*Measurements of holotype in hundredths of length to base of caudal* (87 mm.): depth of body, 22; depth of caudal peduncle, 7; length of head, 37; snout, 10; orbit, 7; interorbital, 4.5; preopercular spine, from ridge, 8.5; suborbital, 3.5; maxillary, 17; mandible, 18; snout to occiput, 27; occiput to origin of dorsal, 11; base of first dorsal, 19; height of first dorsal (longest ray), 10; base of second dorsal, 36; height of second dorsal, 14; length of caudal (to lower angle), 18; base of anal, 32; height of anal, 11.5; isthmus to anus, 36; length of pectoral (from upper angle), 25; length of pelvic fin, 14. Fin-rays—dorsal, VII-16; anal, 16 (counting the last soft ray as branched); caudal, 11 (9 branched); pectoral, 18; ventral, I, 4.

#### IV

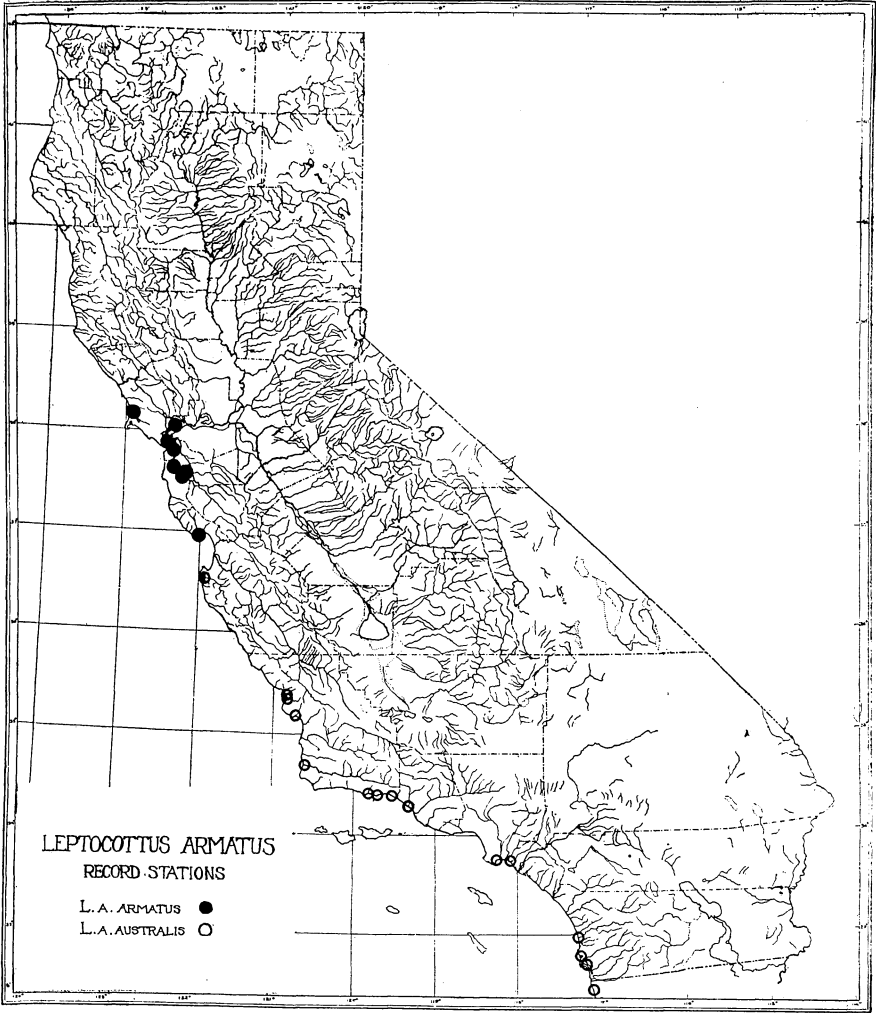
*Leptocottus armatus australis* is abundant throughout its known range. The adults occur along the open shore; the young abound in the bays and estuaries, especially during the spring months. They live in salt, brackish, or fresh water, but apparently do not

ascend the streams far if at all above tidewater. Their movements, like those of most cottoid fishes, are rapid and angular. Upon coming to rest after a short dart through the water, they frequently half bury themselves on the bottom, throwing mud or sand over their bodies by a wriggling movement. The head is often widely dilated when the fish is seized, the strongly antlered preopercular spines projecting outward as weapons of defense. When held in the hand, they were heard to emit a low deep-toned grunt, the belly rapidly vibrating.

The young feed largely on crustaceans, particularly small crabs. The only adult of the subspecies opened, a specimen 182 mm. long to caudal, from Santa Barbara, had also eaten a crab. (An adult of *L. a. armatus* from Florence, Oregon, taken in the mouth of the Suislaw River, contained fish scales in its stomach, probably from a salmon cannery at that place.)







RECORD STATIONS OF *LEPTOCOTTUS ARMATUS* IN CALIFORNIA

