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a single extended reproductive
situation being similar to that
testinalis in Germany. Experi-
arval stages are short and do

not travel far. Oysters and mussels raised above the substrate are not infested.

The most frequently infested host is *M. edulis*, followed by *C. gigas* and *O. lurida*. Less often *M. californianus* (Chew et al., 1964) and the butter clam *Saxidomus giganteus* may be host to the copepod.

Up to the present there are no indications that *M. orientalis* is of any economic significance in the British Columbia shellfish industry.

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Sinistrality in *Platichthys stellatus* off British Columbia

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FORRESTER, C. R. 1969. *Sinistrality in Platichthys stellatus off British Columbia.* J. Fish. Res. Bd. Canada 26: 191–196.

Percentage sinistrality in the starry flounder (*Platichthys stellatus*) off British Columbia was found to increase proceeding from south to north, and on the average (66%) was greater than that found off the western coast of the United States, and close to that found off Alaska.

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FLATFISHES OF the family Pleuronectidae in the North Pacific are normally dextral, i.e., have eyes and coloration on the right side of the fish. Most frequent exceptions to this pattern occur in the starry flounder, *Platichthys stellatus*,

Printed in Canada

and several authors have shown that reversal in this species is widespread (Norman, 1934; Gudger, 1935; Townsend, 1937). Summaries of sampling conducted from Monterey Bay, California, north through the Gulf of Alaska and off Japan showed that incidence of sinistral specimens of *P. stellatus* ranged from about 50% off Oregon to 100%, or close to 100%, off Japan (Hubbs and Kuronuma, 1942; Orcutt, 1950).

Information on sinistrality or "handedness" in flounders from the British Columbia coast has been collected at intervals since 1945. This previously unpublished material shows that the percentage of sinistral specimens off British Columbia (66.4%) lies above that found for samples taken off Oregon and close to that for samples taken off Kodiak Island and the Alaska Peninsula (Table 1).

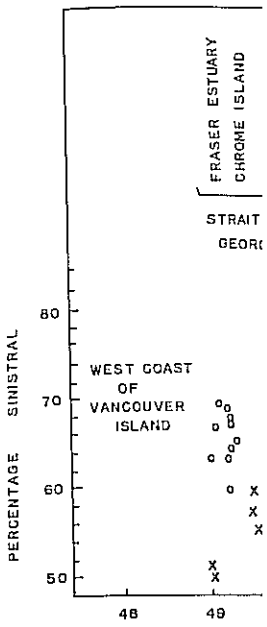
TABLE 1. Percentage occurrences[a] of sinistral specimens of *Platichthys stellatus* in the North Pacific Ocean.

Locality	No. of specimens	Sinistral (%)
California	509	55.2
California (Orcutt, 1950)	1439	59.5
Oregon outer coast	65	49.2
Columbia River mouth	225	60.4
Washington outer coast	247	56.3
Puget Sound	8972	51.6
British Columbia	7671	66.4
Southeastern Alaska	2498	58.2
Kodiak Island and Alaska Peninsula	5129	68.0
Japan	476	100.0

[a]All data except that by Orcutt (1950) for California and that for British Columbia are from table 5 of Hubbs and Kuronuma (1942).

However, use of a single figure to describe sinistrality for a large region may be misleading. Off British Columbia there is a general trend to a higher percentage of sinistral specimens proceeding from southernmost to northern areas (Fig. 1). Off the Fraser River estuary in the southern Strait of Georgia (about 49°N lat) samples of *P. stellatus* are about 51% sinistral, virtually identical to the percentage found in samples from Puget Sound immediately to the south. On the Two Peaks ground of northern Hecate Strait (54°20′N lat) samples are about 78% sinistral.

The most anomalous data in Fig. 1 are those from grounds off the west coast of Vancouver Island (about 49°N lat). However, there is more reason to consider the west coast samples in conjunction with offshore samples rather than with the inshore and Strait of Georgia samples. In this context the mean of 65.4% for the west coast lies between the 50–60% sinistral observed off the Oregon and Washington coasts, respectively, and the 76% for all of Hecate Strait.



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	68.0
	100.0

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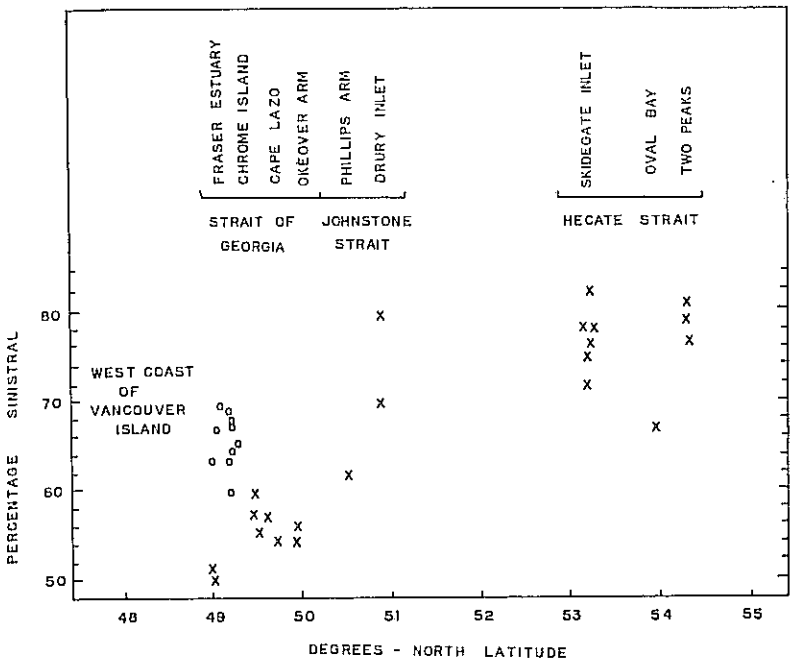

FIG. 1. Percentage sinistrality in *Platichthys stellatus* among samples collected off British Columbia. Data from west coast of Vancouver Island are shown by open circles.

The British Columbia samples were examined for: (1) the between-year variation within an area of percentage sinistral by comparable length intervals; (2) the between-area variation in percentage sinistral by comparable length intervals (percentages were transformed to angles prior to calculation); (3) within-year variation in an area of percentage sinistral by size groups.

Analysis of variance on seven sets of within-area data showed that between-year variations in an area were greater than between-length variations (Table 2) but neither between-year nor between-length variations were significant ($P < 0.05$). All four tests of between-area variations showed significant differences between areas. There were differences between samples taken off the west coast of Vancouver Island and Hecate Strait, between those from the west coast of Vancouver Island and the Fraser River estuary, between those from Hecate Strait and the Fraser River estuary, and between those from Cape Lazo and the Fraser River estuary. Chi-square tests on the numbers sinistral and dextral by length-groups within samples showed no apparent trend within samples and total chi-squares were not significant ($P < 0.05$; Table 4). This suggests no differential viability between dextral and sinistral forms of *P. stellatus*.

For the tests to be completely meaningful, the length groups compared between areas should represent the same year-classes. If growth differences exist between areas it might weaken the comparison. Further, comparisons of

TABLE 2. Results of analysis of variance tests for between-year and between-area variations in percentage sinistral in *Platichthys stellatus* off British Columbia.

Area	Years	Source of variance	df	F ratio
		Between years		
Lower west coast of Vancouver Is.	1955, 1959-61	Between years	3	1.06
		Between lengths	4	0.31
		Error (Y × L)	12	
	1962, 1964	Between years	1	1.51
		Between lengths	3	0.21
		Error (Y × L)	3	
Fraser R.	1957, 1962	Between years	1	3.75
		Between lengths	3	0.32
		Error (Y × L)	3	
Cape Lazo	1955, 1958, 1961	Between years	2	1.93
		Between lengths	3	0.25
		Error (Y × L)	6	
	1962, 1964	Between years	1	0.55
		Between lengths	2	0.09
		Error (Y × L)	2	
Upper Hecate Strait	1946, 1947	Between years	1	0.26
		Between lengths	3	0.32
		Error (Y × L)	3	
	1963, 1964	Between years	1	1.35
		Between lengths	4	0.96
		Error (Y × L)	4	
		Between areas		
Lower west coast of Vancouver Is. and Hecate Strait		Between areas	1	11.27
		Between lengths	7	0.55
		Error (A × L)	7	
Lower west coast of Vancouver Is. and Fraser R. estuary		Between areas	1	15.33
		Between lengths	4	2.35
		Error (A × L)	4	
Hecate Strait and Fraser R. estuary		Between areas	1	31.49
		Between lengths	4	2.36
		Error (A × L)	4	
Cape Lazo and Fraser R. estuary		Between areas	1	9.01
		Between lengths	4	4.91
		Error (A × L)	4	

TABLE 3. Percentage sinistral by size groups in *Platichthys stellatus* off British Columbia. Number in a size group was 20 or greater.

Midpoint of length	Lower west coast Vancouver Is.		Johnstone Strait		Fraser R.		Cape Lazo			Upper Hecate Strait			
	1955	1959	1960	1961	1957	1962	1955	1958	1961	1962	1946	1947	1963	1964

sinistrality within an area to determine differences in viability should be made on fish of the same year-class or classes in successive time intervals. The sampling was not intensive enough to permit such a study. Although the conclusions are tentative, they do suggest the presence of a number of discrete local stocks of *P. stellatus*.

TABLE 3. Percentage sinistral by size groups in *Platichthys stellatus* off British Columbia. Number in a size group was 20 or greater.

Midpoint of length interval (*cm*)	Lower west coast Vancouver Is.						Johnstone Strait			Fraser R.		Cape Lazo					Upper Hecate Strait					
	1955	1959	1960	1961	1962	1964	1960	1961	1964	1957	1962	1955	1958	1961	1962	1964	1946	1947	1961	1962	1963	1964
32																39						
35								71			49	62	73	50		55						
38			66				76	71	74	49	47	48	71	58		55						
41			60		62	61	66	63	51	55	43	44	63	60	64	52				61	68	
44	54	78	65	68	71	64	64	61	62	49	49	54	52	65	46	67	75	89		66	88	
47	53	62	67	64	63	66	78	57	57	55	48	73			55	68	81	73	85	61	83	78
50	65	64	68	61	74	52	67	62			68	71			62		74	79	75	71	73	79
53	68	75	59	65	64		73	55									79	77	80	72	79	76
56	76	70	63	52			67	56										72	76	89	75	96
59		59	64																77		67	76
62		65																	82		81	
65																			82		87	
68																			73			
No. of fish	117	273	414	176	169	125	285	645	155	177	262	209	144	199	134	350	215	249	679	374	529	166

TABLE 4. Results of chi-square tests of numbers sinistral and dextral in various length groups of *Platichthys stellatus*.

Area	Year	No. of length intervals[a]	No. of fish	Chi-square	df
Lower west coast of Vancouver Is.	1955	5	117	3.79	4
	1959	7	273	5.24	6
	1960	8	414	2.01	7
	1961	5	176	1.70	4
	1962	5	169	1.89	4
	1964	4	125	1.03	3
Johnstone Strait	1960	7	285	4.03	6
	1961	8	645	7.65	7
	1964	4	155	4.13	3
Fraser R.	1957	4	177	0.69	3
	1962	6	262	4.23	5
Cape Lazo	1955	6	209	9.90	5
	1958	4	144	4.20	3
	1961	4	199	2.21	3
	1962	4	134	2.46	3
	1964	6	350	6.97	5
Upper Hecate Strait	1946	4	215	1.08	3
	1947	5	249	3.09	4
	1961	8	679	3.74	7
	1962	6	374	9.47	5
	1963	9	529	12.11	8
	1964	5	166	4.45	4

[a]See Table 3.

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