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ECOLOGICAL SURVEY OF DEMERSAL FISHES IN THE DUWAMISH
RIVER AND AT WEST POINT, 1974

by

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CONTENTS

	Page
INTRODUCTION	1
MATERIALS AND METHODS	1
Duwamish River	1
West Point	3
RESULTS	3
Duwamish River Study	3
General Catch Results	3
Disease Occurrence Results	9
West Point Study	14
General Catch Results	14
Beach Seining	14
Otter Trawling	24
Disease Occurrence Results	27
ACKNOWLEDGMENTS	31
LITERATURE CITED	31
APPENDICES	32

ECOLOGICAL SURVEY OF DEMERSAL FISHES IN THE DUWAMISH
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Introduction

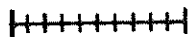
During 1974, the Fisheries Research Institute at the University of Washington conducted sampling of demersal fishes in the Duwamish River and at West Point. The objectives of both sampling programs were to: (1) Obtain data on species composition, distribution, abundance, and community structure; and (2) obtain information on disease incidence and parasite infestation. Disease studies have emphasized fin rot, tumors, and nematode parasites. This progress report describes sampling procedures and preliminary results of these investigations for the year 1974. More intensive studies are currently in progress as part of METRO's "Puget Sound Interim Studies" program.

Materials and Methods

Duwamish River. Sampling was conducted monthly (except October) using a Boston Whaler and a 5m otter trawl with a cod end mesh size of 6 mm. Single five-minute hauls were made at each of eight stations (A-H) in the lower river (Fig. 1). Catches were bagged separately in the field, held on ice, and returned to the laboratory for processing. Processing was generally completed within two days and included identification, enumeration, external sexing, and examination for fin rot, tumors, and nematodes. For all flatfishes, total length was measured to the nearest millimeter and total wet weight recorded to the nearest 0.1 g. In addition, otoliths were removed from 50 normal and all diseased Platichthys stellatus each month in order to obtain

DUWAMISH WATERWAY

SCALE 1:40,000



1000 yards 0

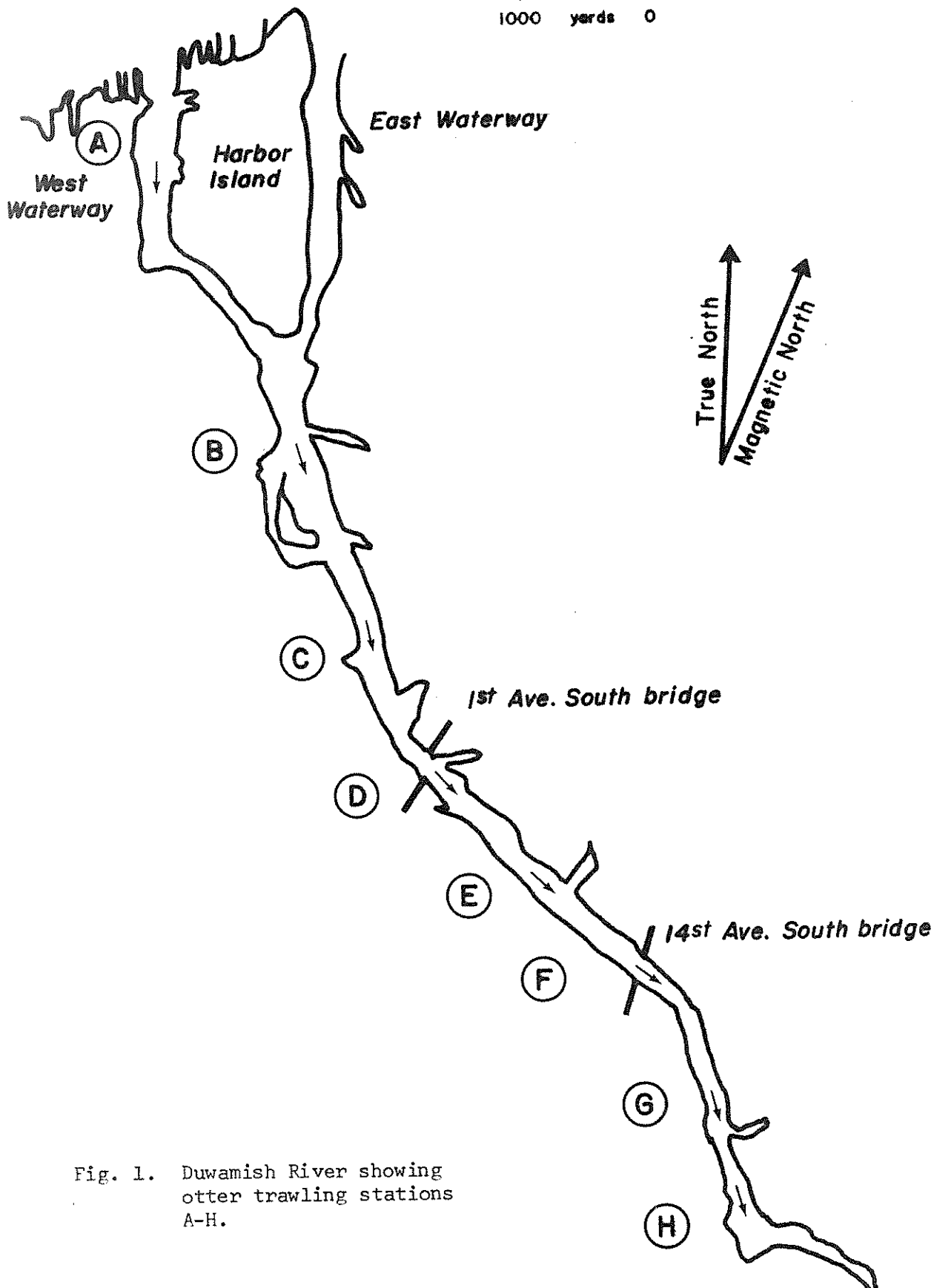


Fig. 1. Duwamish River showing otter trawling stations A-H.

information on age and growth. At present, all data have been keypunched for future storage on magnetic tape.

West Point. Sampling was conducted monthly (Fig. 2) using both a 5m otter trawl and a 9m beach seine (both nets with cod end mesh size of 6 mm). Beach seine sites alternated monthly between the north and south beaches, beginning with the north beach in January 1974 (except for March, owing to inclement weather). All seining was conducted at the lowest tide of the month and five replicate hauls (30 m each) were taken parallel to shore. Otter trawls were made monthly (except for February owing to inclement weather) at 5 m, 45 m, and 75 m or 95 m. Two hauls were taken at each depth, one north and the other south of West Point. During June, August, September, October, and November, the deepest trawl was made at 75 m, whereas in all other months the deepest haul was at 95 m. All specimens collected were held separately by haul, placed on ice, and returned to the laboratory for subsequent processing. Catch processing was identical to that for Duwamish River samples, except that otoliths were not removed from Platichthys stellatus, and total weights were obtained for all specimens of all species.

Results

I. Duwamish River Study

A. General Catch Results

A total of 6,547 individuals in 29 species were collected during the course of 1974 sampling (Table 1 and Appendix 1). The five most abundant species exhibited seasonal variation in abundance, but generally comprised about 90% of the total catch (Table 2). The

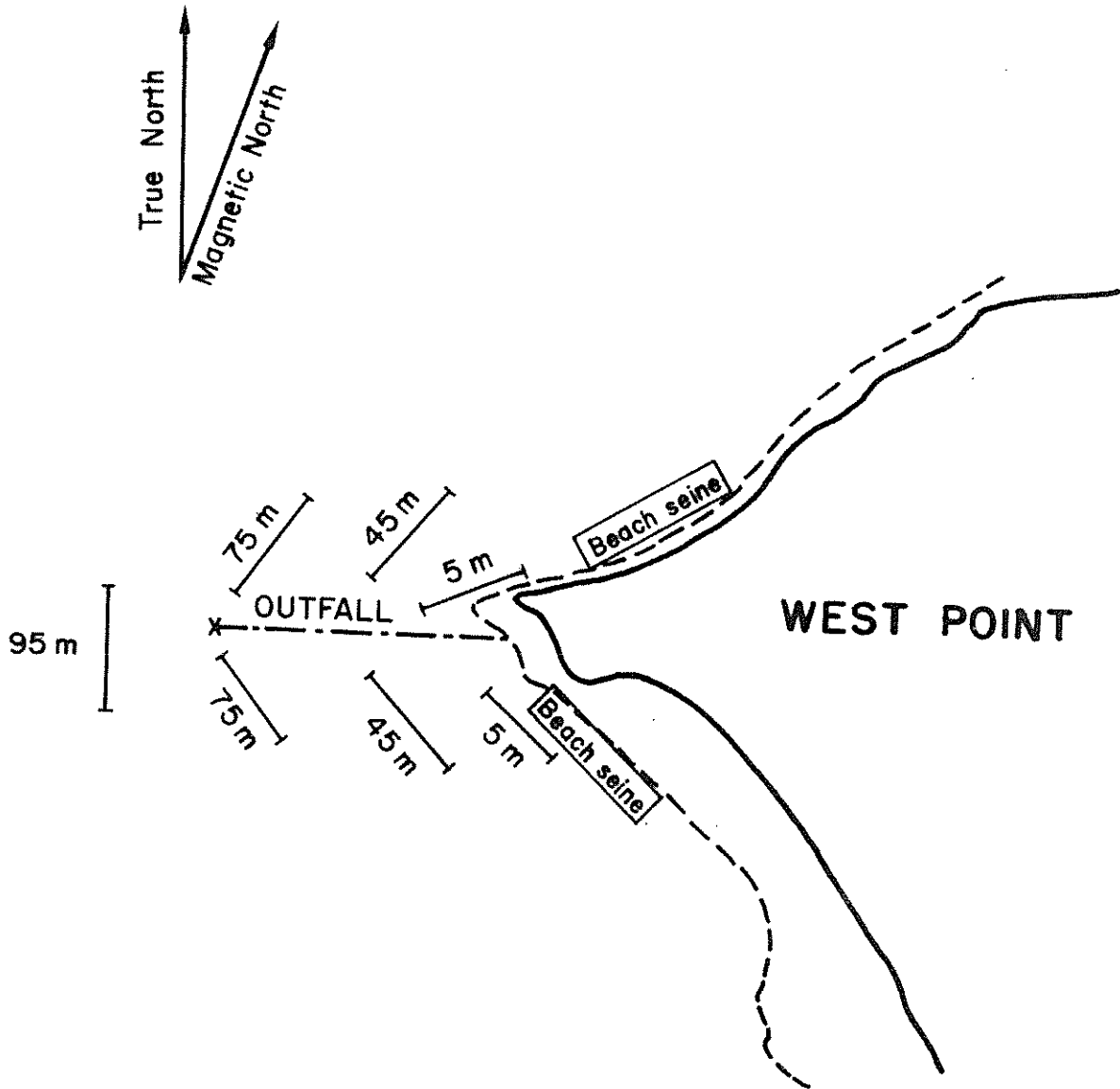


Fig. 2. West Point study area showing beach seining (BS) and other trawling stations (depth in meters).

Table 1. List of species collected in Duwamish River during 1974.
Presence or absence noted by station (refer to Fig. 1).

Species	Total Number	Stations							
		A	B	C	D	E	F	G	H
<i>Spirinchus thaleichthys</i>	1,690	x	x	x	x	x	x	x	x
<i>Platichthys stellatus</i>	1,218		x	x	x	x	x	x	x
<i>Parophrys vetulus</i>	1,483	x	x	x	x	x	x	x	x
<i>Leptocottus armatus</i>	863	x	x	x	x	x	x	x	x
<i>Lumpenus sagitta</i>	663	x	x	x	x	x	x	x	x
<i>Microgadus proximus</i>	199	x	x	x	x	x	x	x	
<i>Lepidopsetta bilineata</i>	125	x	x	x	x	x	x	x	
<i>Psettichthys melanostictus</i>	90	x	x	x	x	x	x	x	
<i>Microstomus pacificus</i>	55	x	x	x					
<i>Cymatogaster aggregata</i>	54	x		x	x	x	x	x	x
<i>Artedius fenestralis</i>	32	x	x	x	x	x		x	
<i>Rhacochilus vacca</i>	18		x		x		x		
<i>Clupea harengus</i>	12	x			x	x	x	x	x
<i>Hydrolagus colliei</i>	9	x	x						
<i>Oncorhynchus tshawytscha</i>	5						x		x
<i>Enophrys bison</i>	4		x	x					
<i>Gadus macrocephalus</i>	4	x		x					
<i>Theragra chalcogramma</i>	4				x		x		
<i>Lepidogobius lepidus</i>	4		x				x		
<i>Embiotoca lateralis</i>	3	x	x						
<i>Hexagrammus stelleri</i>	2	x		x					
<i>Hippoglossoides elassodon</i>	2				x				
<i>Cottus asper</i>	2								x
<i>Squalus acanthias</i>	1	x							
<i>Odontopyxis trispinosa</i>	1	x							
<i>Oncorhynchus kisutch</i>	1								x
<i>Catostomus macrocheilus</i>	1							x	
<i>Porichthys notatus</i>	1	x							
<i>Chitonotus pugetensis</i>	1			x					

Table 2. Relative seasonal abundance of five most dominant species collected in the Duwamish River during 1974.

Species	Jan- Feb	March- April	May- June	July- Aug	Sept- Oct	Nov- Dec
<i>Spirinthus thaleichthys</i>	2.3%	4.8%	1.3%	30.8%	31.6%	47.3%
<i>Platichthys stellatus</i>	56.1	57.4	25.7	6.7	10.9	3.4
<i>Parophrys vetulus</i>	22.9	17.2	32.4	16.0	18.6	21.8
<i>Leptocottus armatus</i>	7.5	10.3	20.0	14.3	20.4	10.9
<i>Lumpenus sagitta</i>	0.3	0.2	8.8	22.4	8.1	6.3
Other species	10.9	10.1	11.8	9.8	10.4	10.3

vast majority of species (22/29 - 75.9%) comprised less than 1.0% of the total catch, thus patterns of seasonal abundance for these species are not clear. The five most abundant species were generally collected at all eight stations, with one notable exception. Both Parophrys vetulus (English sole) and Platichthys stellatus (starry flounder) had skewed distributions, with the former dominant at Stations A-C and the latter dominant at Stations D-G. In fact, P. stellatus was never collected at Station A, and P. vetulus was only infrequently collected at Stations G and H.

Overall catch data, combined for all eight stations, were summarized (Fig. 3) and show that species richness (total number of species) was highest between March and June, but dropped off late in the year. Catch per unit effort (numbers) and diversity (Shannon-Wiener Information Index) peaked during July and August, but also decreased late in the year. As noted earlier, the five most abundant species (Spirinchus thaleichthys, Platichthys stellatus, Parophrys vetulus, Leptocottus armatus, and Lumpenus sagitta) invariably comprised 90% of the monthly catch, yet their relative abundance changed dramatically during the year (Table 2). From January to June, P. stellatus and P. vetulus were the dominant forms, but their abundance decreased considerably during the second half of the year. From July to December, S. thaleichthys and P. vetulus dominated, although L. sagitta and L. armatus were occasionally sampled in large numbers.

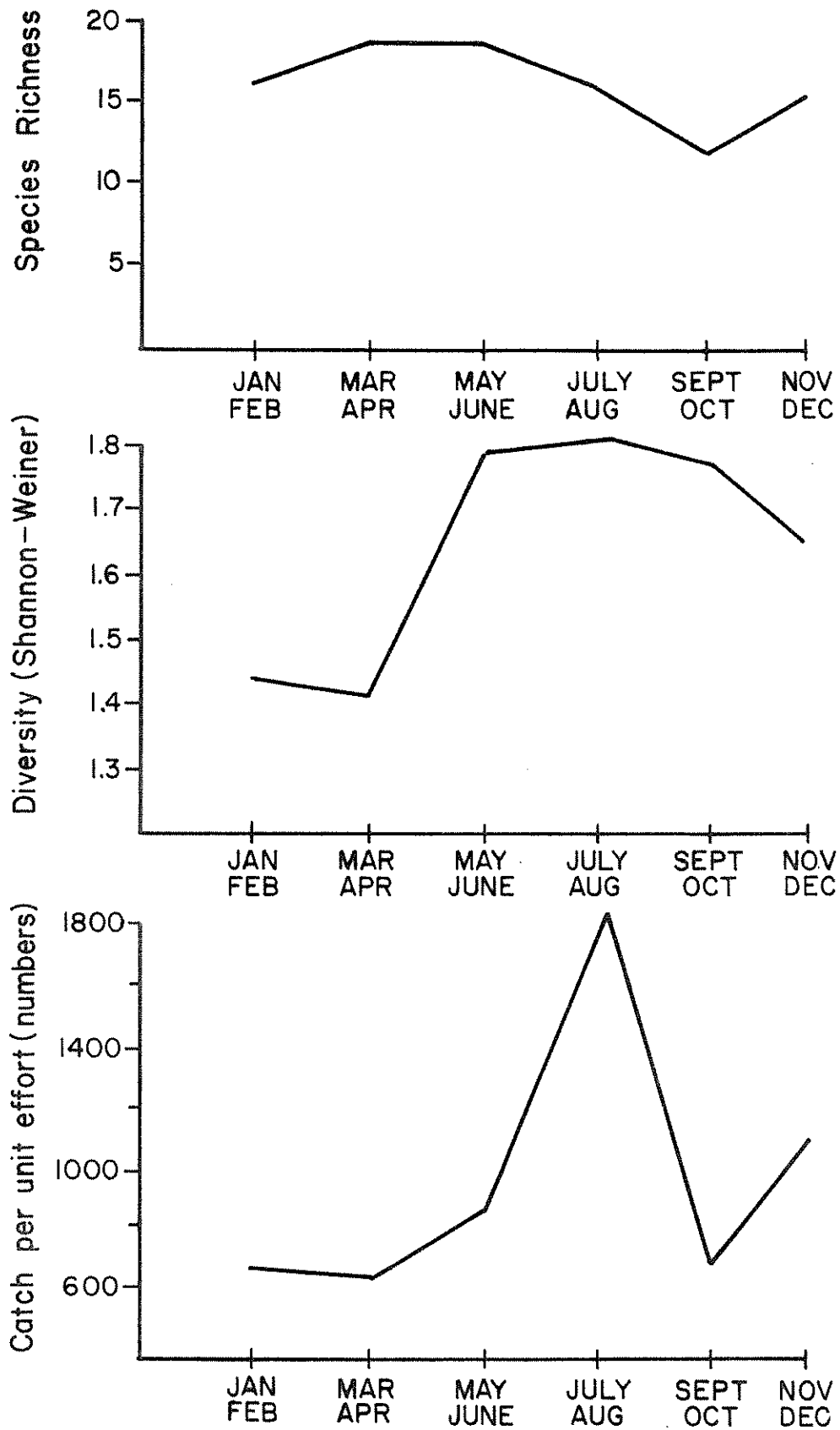


Fig. 3. Species richness, diversity, and catch per unit effort from the Duwamish River for all stations combined during 1974.

B. Disease Occurrence Results

Only tumorous Platichthys stellatus were collected in the Duwamish River. The incidence of angioepithelial nodules (AEN) was generally low and sporadic; however, the incidence of epidermal papillomas (EP) was much higher and exhibited a clear seasonal pattern (Table 3). Incidence of EP tumors was highest in January (19.1%), gradually decreased to 0% in August, and then increased again at the end of the year. Incidence of tumors also appeared heavily dependent on the area of the river sampled. Tumorous P. stellatus were collected only at Stations D-H and the highest incidences occurred at Stations G and H (Table 4). In addition, the location of tumors on individual fishes was not randomly distributed (Table 5). Both AEN and EP tumors were more frequently encountered on the eyed rather than blind side of individual specimens. A large percentage of AEN and EP tumors was found on both sides of the fish; however, these were generally very large or located on the fins.

Fin rot was principally found on Platichthys stellatus, but some Parophrys vetulus occasionally had the disease also. Monthly incidence of fin rot on P. stellatus ranged from 1.6% in July to 14.6% in March, but did not exhibit any clear seasonal pattern (Fig. 4a). In addition, the incidence of fin rot was not associated with any particular station (Fig. 4b). The highest incidence was at Station C, but this was probably due to a very small sample size. The disease was most commonly found on the dorsal, anal, and caudal fins, but it also occurred on the pelvic

Table 3. Precent occurrence by month of AEN and EP tumors on Platichthys stellatus in the Duwamish River during 1974. Actual numbers of tumorous fishes are in parentheses.

Month	Total No. of fish	Percent occurrence	
		AEN	EP
January	204	0.98 (2)	19.1 (39)
February	178	0.0	13.5 (24)
March	157	0.0	8.9 (14)
April	211	0.95 (2)	8.1 (17)
May	127	0.0	7.1 (9)
June	61	0.0	8.2 (5)
July	61	1.6 (1)	3.2 (2)
August	44	0.0	0.0
September	74	2.7 (2)	1.4 (1)
October	(NO SAMPLING CONDUCTED)		
November	62	1.6 (1)	14.5 (9)
December	39	0.0	12.8 (5)
TOTAL	1,218	0.7 (8)	10.3 (125)

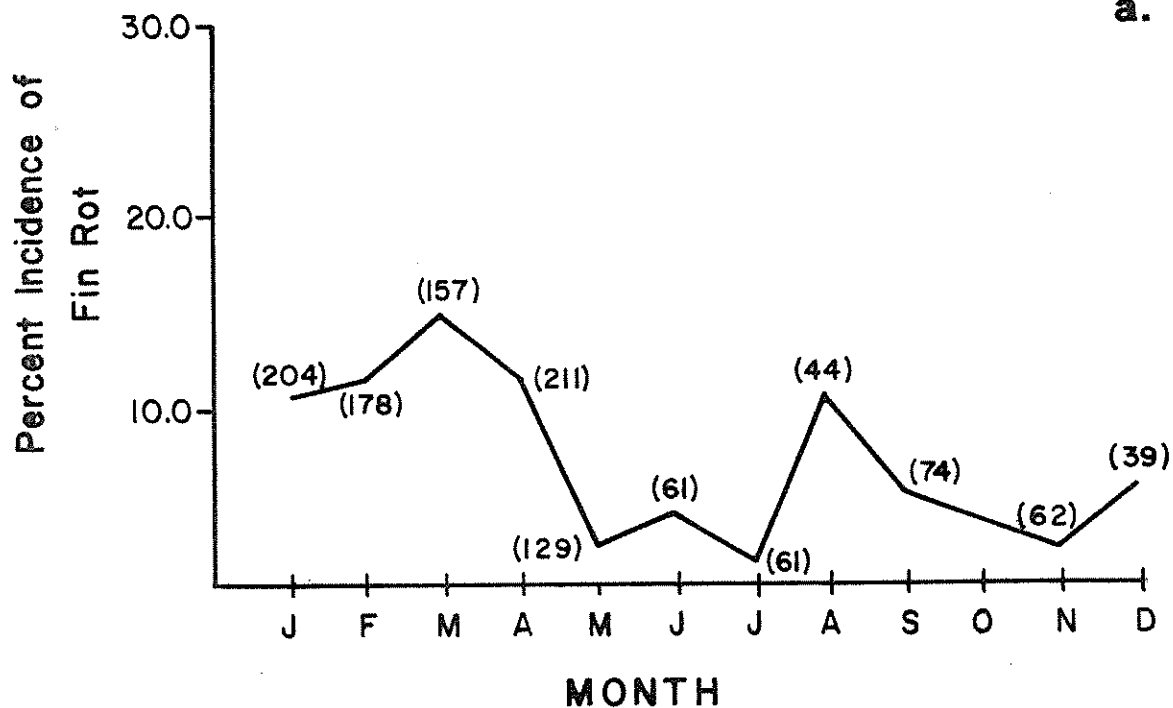
Table 4. Percent occurrence by station (all months combined) of AEN and EP tumors on Platichthys stellatus in the Duwamish River during 1974. Actual numbers of tumorous fishes are in parentheses. Dash indicates no fishes were collected.

Station	Total No. of fish	Percent occurrence	
		AEN	EP
A	0	--	--
B	6	0.0	0.0
C	12	0.0	0.0
D	138	0.0	1.5 (2)
E	218	0.46 (1)	9.6 (21)
F	478	0.40 (2)	12.3 (58)
G	178	1.10 (2)	29.5 (23)
H	149	2.0 (3)	32.6 (16)
TOTAL	1,179	0.69 (8)	10.3 (120)

Table 5. Numbers of AEN and EP tumors on the eyed and blind sides of individual Platichthys stellatus collected in the Duwamish River during 1974.

Month	AEN Tumors			EP Tumors		
	Eyed side	Blind side	Both sides	Eyed side	Blind side	Both sides
January	8	0	5	117	31	116
February	0	0	0	41	13	66
March	0	0	0	10	2	21
April	5	0	2	19	5	10
May	0	0	0	9	3	15
June	0	0	0	3	3	8
July	0	0	0	0	1	2
August	0	0	0	0	0	0
September	6	2	4	2	0	0
October	(N O S A M P L I N G C O N D U C T E D)					
November	1	0	0	0	0	2
December	0	0	0	0	0	0
Total	20	2	11	201	58	240
Percentage of total	61.0	6.0	33.0	40.0	12.0	48.0

a.



b.

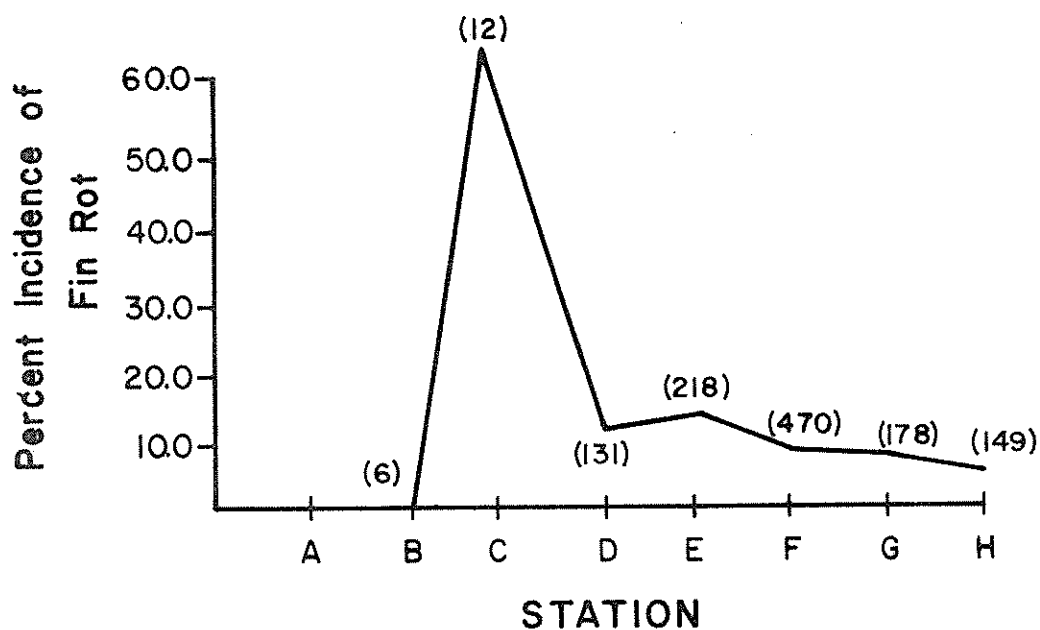


Fig. 4. Percent incidence of fin rot on *Platichthys stellatus* by month (4a) and station (4b) during 1974. Total number of fish is in parentheses.

and pectoral fins (Table 6). The incidence of fin rot was the same on eyed and blind pelvic fins, but the blind pectoral was significantly more diseased than the eyed pectoral fin.

Infestation by the nematode Philometra ("bloodworms") was observed in P. stellatus (0.25%), L. bilineata (1.8%), and P. vetulus (7.5%). The monthly incidence of Philometra (Fig. 5a) on P. vetulus varied considerably, but was highest in May and late in the year. In contrast, nematode infestation by station (Fig. 5b) was less variable, and tended to increase with increasing distance up the river.

II. West Point Study

A. General Catch Results

A total of 4,858 individuals in 61 species was collected at West Point during 1974 (Table 7 and Appendix 2). Ten species comprised 83.0% of the overall catch (Table 8), with Parophrys vetulus, Lepidopsetta bilineata and Hydrolagus colliei the dominant forms (61% of the total catch). The largest number of species and individuals were found at the 45m otter trawling depth and in the shallow areas where beach seining was conducted. Both catch per unit effort (numbers) and species richness (total number species) were greatest at 45 m and lowest at 5 m and 75-95 m (Fig. 6).

Beach seining. Species richness varied little throughout the year, whereas catch per unit (numbers) exhibited a large spring-summer increase after the winter season (Fig. 7a). P. vetulus, Platichthys stellatus, and Leptocottus armatus were consistently

Table 6. Occurrence of fin rot disease by fin on individual Platichthys stellatus collected from the Duwamish River during 1974 (all stations and months combined).

Month	Dorsal	Anal	Caudal	Eyed pectoral	Blind pectoral	Eyed pelvic	Blind pelvic
January	21	14	6	0	2	3	3
February	16	7	5	2	8	1	1
March	18	10	6	3	6	5	5
April	14	16	7	0	2	0	0
May	4	0	1	1	1	4	4
June	2	2	1	0	0	0	0
July	2	1	2	0	0	1	1
August	3	1	5	0	0	0	0
September	3	3	4	1	1	1	1
October	(N O S A M P L I N G C O N D U C T E D)						
November	2	2	1	0	0	0	0
December	3	3	1	0	1	0	0
TOTAL	88	59	39	7	21	15	15

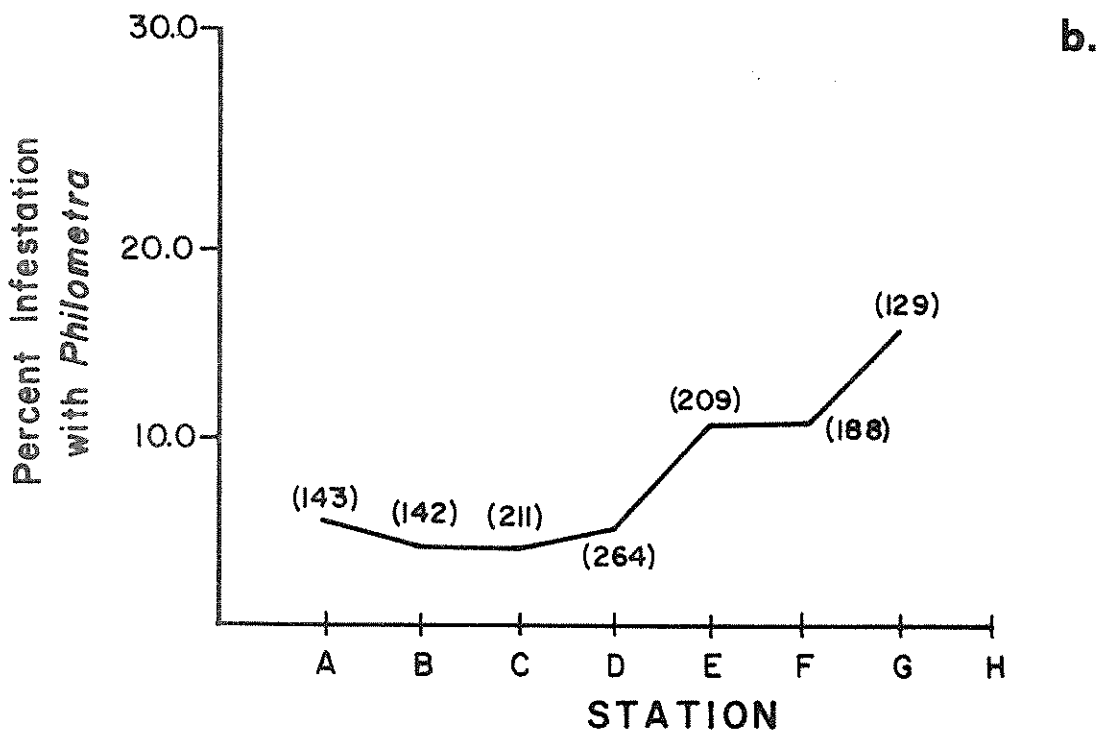
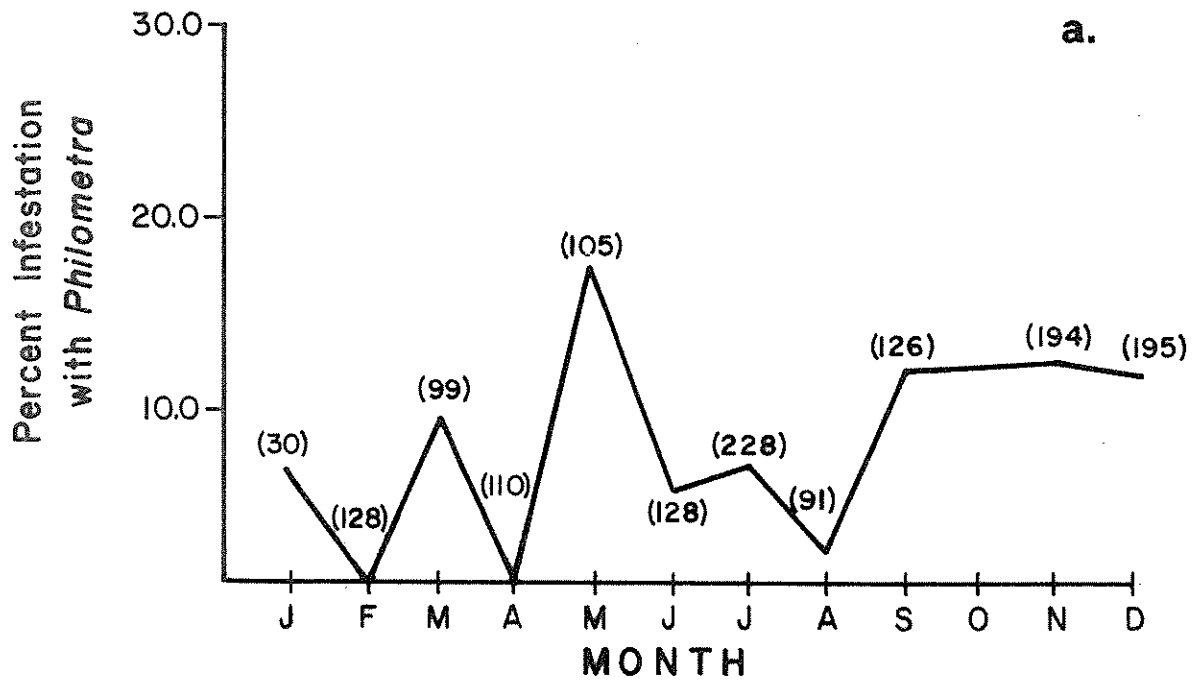


Fig. 5. Percent infestation of *Parophrys vetulus* with *Philometra* by month (5a) and station (5b) in the Duwamish River during 1974. Total number of fish collected is in parentheses.

Table 7. List of species collected in vicinity of West Point.
Presence or absence of species noted by depth.

Species	Total Number	Beach Seine < 5m	Otter trawl			
			5m	45m	75	or 95m
<i>Parophrys vetulus</i>	1,831	x	x	x		x
<i>Hydrolagus colliei</i>	497		x	x		x
<i>Lepidopsetta bilineata</i>	438	x	x	x		x
<i>Cymatogaster aggregata</i>	296	x	x	x		x
<i>Microgadus proximus</i>	209	x	x	x		x
<i>Platichthys stellatus</i>	153	x	x			
<i>Oncorhynchus gorbuscha</i>	149	x				
<i>Microstomus pacificus</i>	147	x		x		x
<i>Leptocottus armatus</i>	122	x	x	x		
<i>Embiotoca lateralis</i>	88	x	x	x		
<i>Citharichthys sordidus</i>	67		x	x		x
<i>Pleuronichthys coenosus</i>	63	x	x	x		
<i>Rhacochilus vacca</i>	56	x	x	x		
<i>Ronquilus jordani</i>	51			x		x
<i>Psettichthys melanostictus</i>	50	x	x			x
<i>Sebastes caurinus</i>	42		x	x		x
<i>Gasterosteus aculeatus</i>	33	x				
<i>Lyopsetta exilis</i>	31		x	x		x
<i>Xeneretmus triacanthus</i>	29			x		x
<i>Aulorhynchus flavidus</i>	29	x	x			
<i>Ammodytes hexapterus</i>	28	x				
<i>Oligocottus maculosus</i>	27	x				
<i>Chitonotus pugetensis</i>	26	x	x	x		x
<i>Glyptocephalus zachirus</i>	24			x		x
<i>Sebastes auriculatus</i>	24		x	x		
<i>Agonus acipensarus</i>	23	x	x	x		x
<i>Citharichthys stigmaeus</i>	20	x	x	x		
<i>Apodichthys flavidus</i>	19	x				
<i>Lumpenus sagitta</i>	17	x				

Table 7, cont'd

Species	Total Number	Beach Seine < 5m	Otter trawl		
			5m	45m	75 or 95m
<i>Lycodopsis pacifica</i>	16			x	x
<i>Odontopyxis trispinosa</i>	15		x	x	x
<i>Radulinus asprellus</i>	10			x	x
<i>Pholis laeta</i>	14	x			
<i>Syngnathus griseolineatus</i>	10	x			
<i>Artedius fenestralis</i>	9	x	x		
<i>Nautichthys oculo-fasciatus</i>	8			x	x
<i>Asterotheca alascana</i>	8				x
<i>Blepsias cirrhosus</i>	7				
<i>Xeneretus latifrons</i>	6			x	x
<i>Spirinchus thaleichthys</i>	6	x			
<i>Theragra chalcogramma</i>	6			x	x
<i>Gadus macrocephalus</i>	5		x	x	x
<i>Hemilepidotus hemilepidotus</i>	5	x	x		
<i>Asterotheca infraspinata</i>	4			x	
<i>Rhamphocottus richardsoni</i>	3			x	
<i>Agonopsis emmelane</i>	3			x	
<i>Icelinus tenuis</i>	3			x	
<i>Icelinus borealis</i>	3			x	
<i>Porichthys notatus</i>	3	x			x
<i>Clinocottus acuticeps</i>	3	x			
<i>Hypomesus pretiosus</i>	3	x			
<i>Brosmophycis marginata</i>	3				x
<i>Scorpaenichthys marmoratus</i>	3				
<i>Radulinus boloides</i>	1			x	
<i>Merluccius productus</i>	1				x
<i>Sebastes maliger</i>	1				x
<i>Clupea harengus</i>	1	x			
<i>Enophrys bison</i>	1	x			

Table 7, cont'd

Species	Total Number	Beach Seine < 5m	Otter Trawl		
			5m	45m	75 or 95m
<i>Myoxocephalus polyacanthocephalus</i>	1		x		
<i>Squalus acanthias</i>	1			x	
Total No. species	61	33	26	34	27
Total No. individuals	4,864	2,269	725	1,135	735

Table 8. Abundance (number of individuals) by depth of the ten dominant species at West Point during 1974. Percentage of the total indicated in parentheses.

Rank	Species	Beach Seine	Otter trawl				Total
		< 5m	5m	45m	75 or 95m		
1	<i>Parophrys vetulus</i>	1,240 (55.6)	301 (41.5)	317 (28.0)	26 (3.5)	1,884 (40.8)	
2	<i>Hydrolagus colliei</i>	0	4 (0.6)	30 (2.7)	463 (63.2)	497 (10.2)	
3	<i>Lepidopsetta bilineata</i>	56 (2.4)	167 (23.1)	264 (23.3)	2 (0.3)	489 (10.1)	
4	<i>Cymatogaster aggregata</i>	167 (7.4)	43 (5.9)	83 (7.3)	3 (0.4)	296 (6.1)	
5	<i>Microgadus proximus</i>	98 (4.3)	3 (0.4)	85 (7.5)	23 (3.1)	209 (4.3)	
6	<i>Platichthys stellatus</i>	151 (6.7)	2 (0.2)	0	0	153 (3.2)	
7	<i>Oncorhynchus gorbuscha</i>	149 (6.5)	0	0	0	149 (3.1)	
8	<i>Microstomus pacificus</i>	1 (0.1)	0	44 (3.9)	102 (13.9)	147 (3.0)	
9	<i>Leptocottus armatus</i>	118 (5.2)	2 (0.2)	2 (0.2)	0	122 (2.5)	
10	<i>Embiotoca lateralis</i>	43 (1.9)	44 (6.1)	1 (0.1)	0	88 (1.8)	
TOTAL		2,023 (90.1)	566 (78.0)	826 (73.0)	619 (84.4)	4,034 (83.0)	

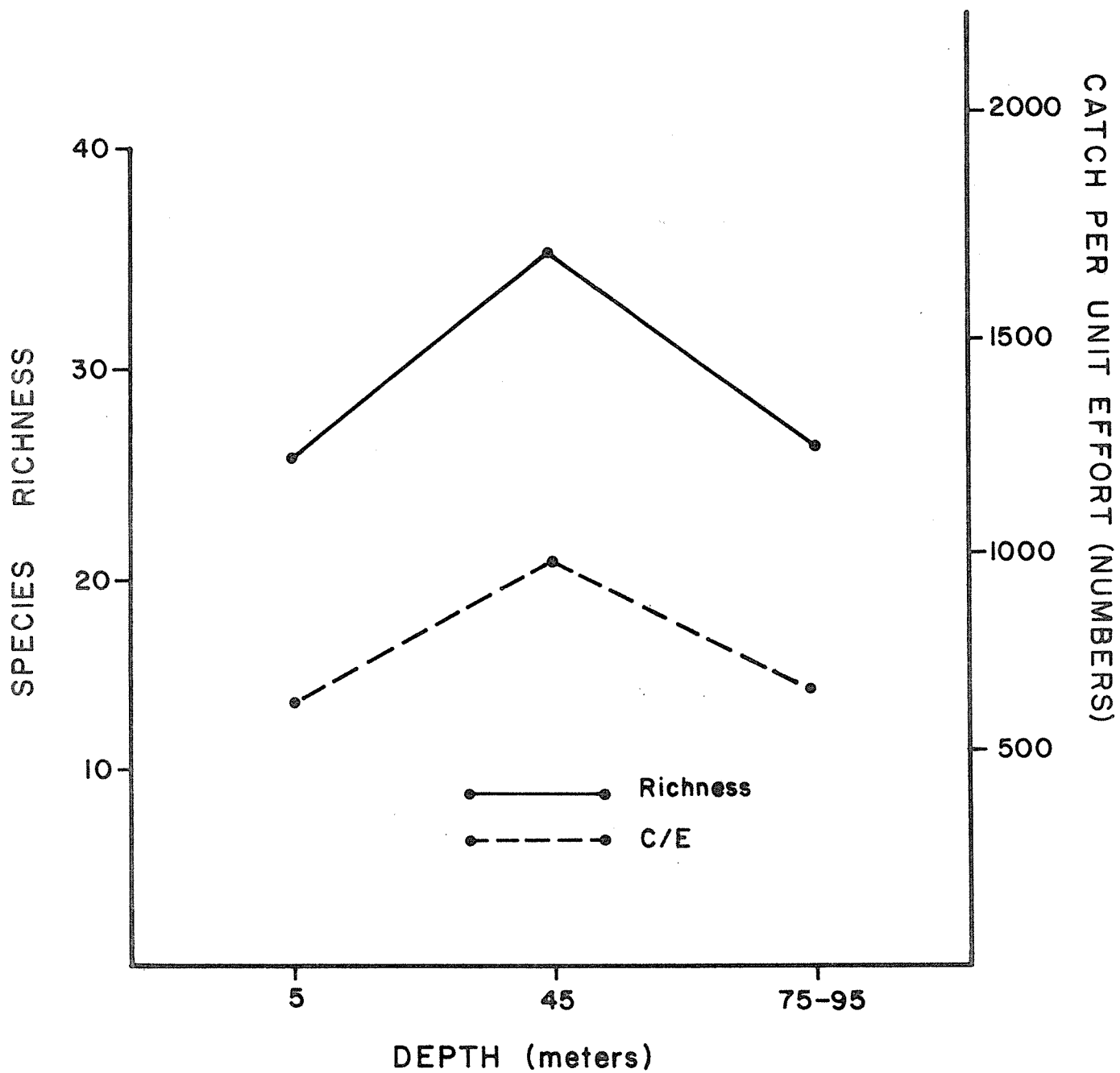


Fig. 6. Overall species richness (total number of species) and catch per unit effort (numbers) by depth during 1974 (all months combined).

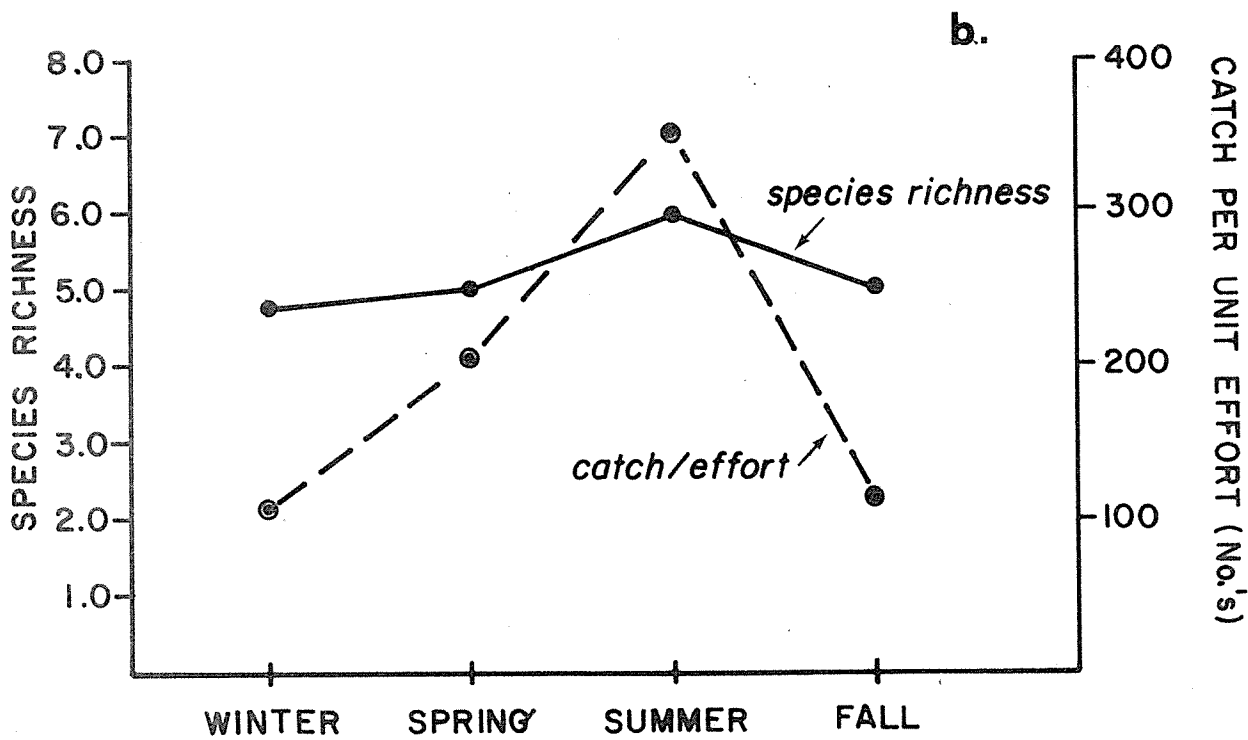
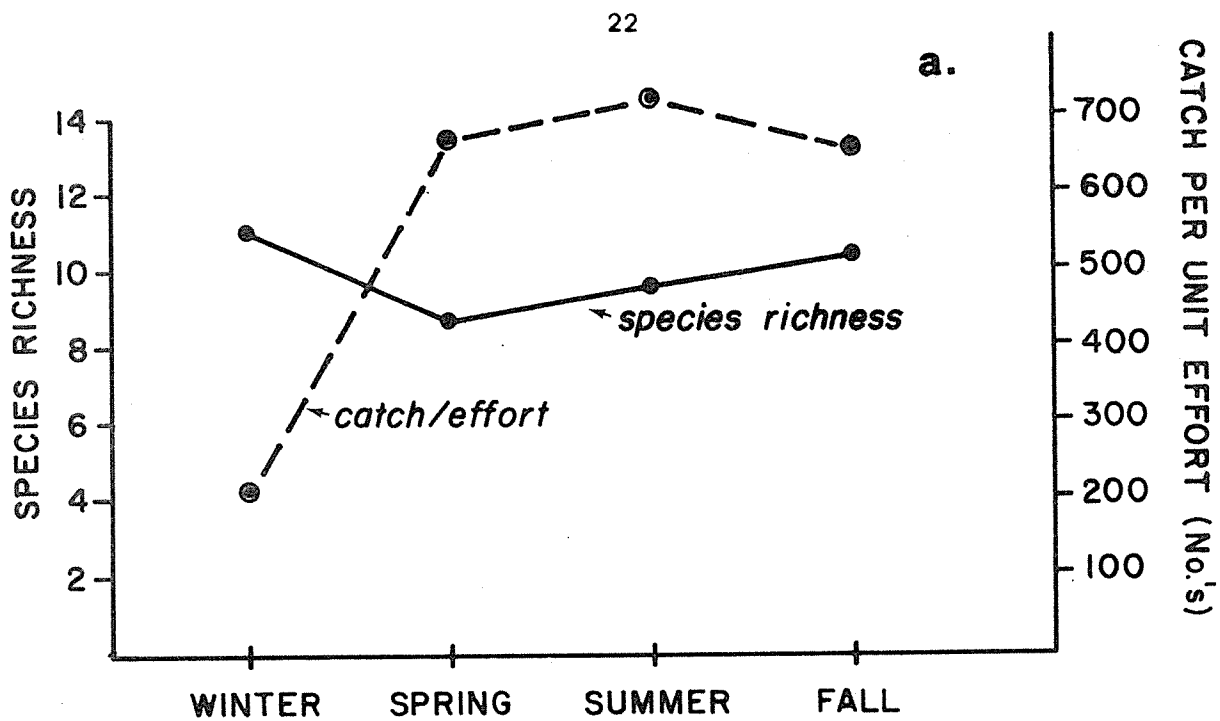
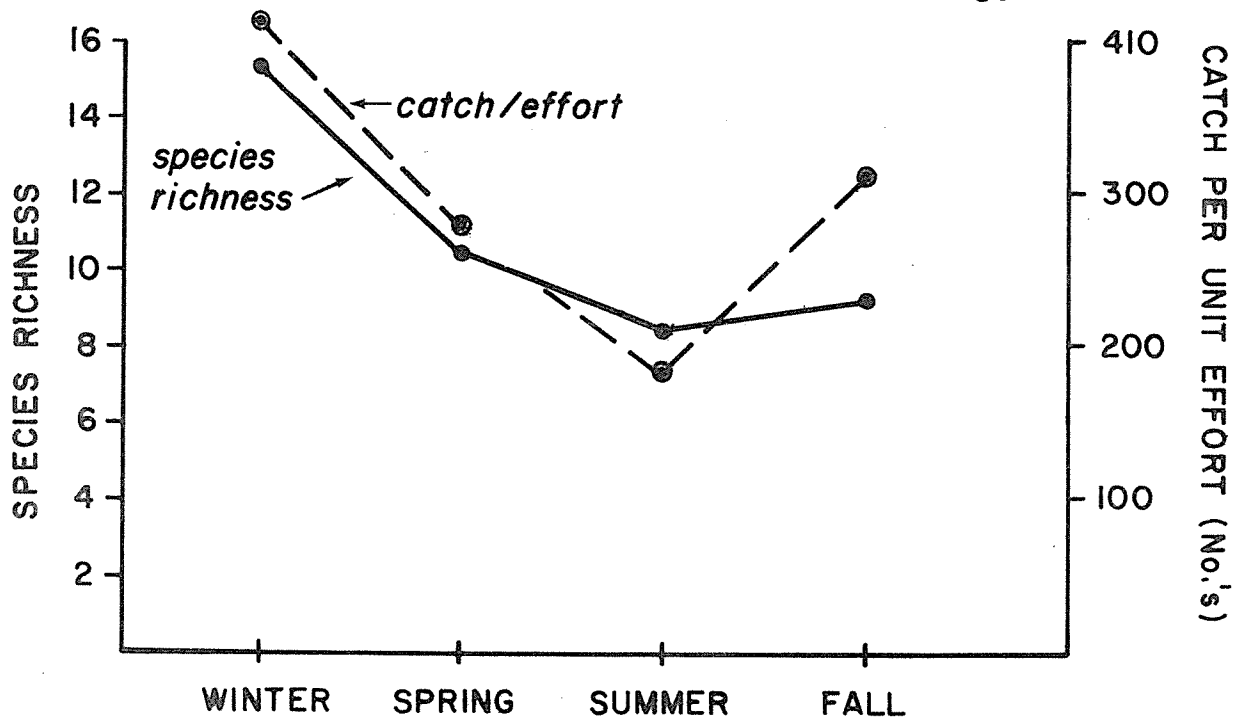


Fig. 7. Species richness and catch per unit effort at West Point for beach seining (7a) and 5 meter otter trawling depth (7b).

c.



d.

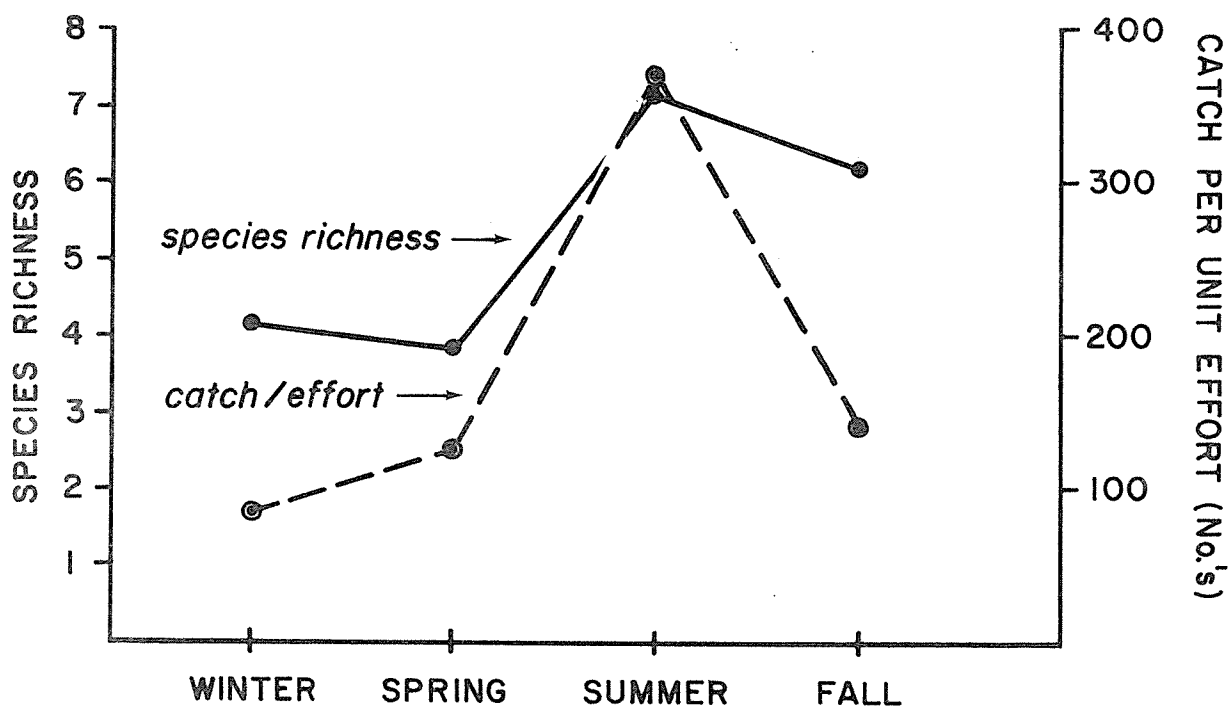


Fig. 7. Species richness and catch per unit effort at West Point for 45 meter (7c) and 75-95 meter (7d) otter trawling depths - cont'd.

present in all months; however, P. vetulus was the overwhelmingly dominant species (Table 9a). Cymatogaster aggregata and Oncorhynchus gorbuscha also occurred in relatively large numbers, but only on a seasonal basis.

Otter trawling. Species richness at 5 m was relatively constant during the year, but peaked slightly in the summer (Fig. 7b). In contrast, catch per unit effort showed a dramatic increase in the summer from winter and spring followed by a rapid fall decline. P. vetulus also dominated at this depth (Table 9b), but L. bilineata and Pleuronichthys coenosus were relatively abundant as well. Together these three species comprised some 67% of the year's catch at 5 m. Two surf perches, Embiotoca lateralis and C. aggregata, comprised 11.0% of the catch, but they were only seasonally abundant in the summer and fall.

Species richness at 45 m exhibited a peak in the winter and then a rapid decrease during the spring and summer (Fig. 7c). Catch per unit effort followed the same pattern, but increased more dramatically during the fall. P. vetulus and L. bilineata dominated the catch (48.4% of the total), but Citharichthys sordidus was usually present in low numbers (Table 9c). Microgadus proximus and C. aggregata were less abundant (14% of total catch) and occurred seasonally with the former primarily in the fall and the latter primarily in winter.

Patterns of species richness and catch per unit effort (numbers) at 75-95 m were similar to those at 5 m, although species richness fluctuated more. Both species richness and catch per unit effort

Table 9a. Relative seasonal abundance of the five most dominant species at beach seining sites.

Species	Winter	Spring	Summer	Fall
<i>Parophrys vetulus</i>	31.5%	39.6%	85.7%	43.3%
<i>Cymatogaster aggregata</i>	5.8	0.0	0.3	19.6
<i>Platichthys stellatus</i>	1.9	1.1	2.2	1.2
<i>Oncorhynchus gorbuscha</i>	0.0	22.1	0.0	0.0
<i>Leptocottus armatus</i>	11.2	4.1	2.6	7.5
TOTAL	50.4%	66.9%	90.8%	71.6%

Table 9b. Relative seasonal abundance of the five most dominant species at 5 m.

Species	Winter	Spring	Summer	Fall
<i>Parophrys vetulus</i>	63.7%	31.5%	23.1%	39.1%
<i>Lepidopsetta bilineata</i>	15.6	31.1	15.4	25.7
<i>Pleuronichthys coenosus</i>	9.8	10.2	3.2	11.7
<i>Embiotoca lateralis</i>	0.0	0.0	28.6	6.3
<i>Cymatogaster aggregata</i>	0.0	0.0	12.3	0.0
TOTAL	89.1%	72.8%	82.6%	82.8%

Table 9c. Relative seasonal abundance of the five most dominant species at 45 m.

Species	Winter	Spring	Summer	Fall
<i>Parophrys vetulus</i>	24.6%	31.3%	15.6%	30.3%
<i>Lepidopsetta bilineata</i>	22.3	16.8	30.7	17.9
<i>Microgadus proximus</i>	5.8	0.0	1.7	17.3
<i>Cymatogaster aggregata</i>	15.9	3.2	0.5	1.6
<i>Citharichthys sordidus</i>	4.2	4.5	10.6	3.9
TOTAL	72.8%	55.8%	59.1%	71.0%

Table 9d. Relative seasonal abundance of the five most dominant species at 75-95 m.

Species	Winter	Spring	Summer	Fall
<i>Hydrolagus colliei</i>	64.4%	63.6%	67.8%	59.6%
<i>Microstomus pacificus</i>	13.8	19.6	11.9	6.3
<i>Parophrys vetulus</i>	5.7	3.0	2.8	3.5
<i>Microgadus proximus</i>	0.0	0.0	0.6	14.9
<i>Lyopsetta exilis</i>	0.0	1.5	3.7	2.8
TOTAL	83.9%	87.7%	86.8%	87.1%

increased rapidly during spring and peaked in the summer, followed by a fall decline (Fig. 7d). Hydrolagus colliei and Microstomus pacificus comprised nearly 80% of the catch and dominated throughout the year. P. vetulus and Lyopsetta exilis occurred in fewer numbers, but were generally present much of the year (Table 9d).

B. Disease Occurrence Results

Only tumorous Parophrys vetulus and Glyptocephalus zachirus (a single individual) were collected at West Point. The overall incidence of AEN and EP tumors on P. vetulus was 3.9% and followed a seasonal pattern (Table 10). Tumor incidence was lowest during the spring and summer (0-3.8%), but increased during the latter portion of the year. Omitting the February sample which was small, the highest incidence (30/208) occurred in October. Tumorous P. vetulus were also more abundant on the south beach (60.9%) than the north beach (39.1%) (Table 10). A previous study of the West Point vicinity during 1973 (Moulton and Miller, et al., 1974) has also shown that tumorous P. vetulus are more frequent on the south beach. In addition, neither AEN nor EP tumors were consistently observed on the eyed or blind side of individual fishes (Table 11).

P. vetulus, L. bilineata, Psettichthys melanosticus, and Citharichthys sordidus were all found to be infested with the parasitic nematode Philometra, but only P. vetulus (2.2%) and L. bilineata (2.9%) were infected in high numbers. In general, percent incidence of infestation for both species did not exhibit any seasonal periodicity (Table 12).

Table 10. Percentage of tumorous Parophrys vetulus collected at West Point during 1974 (actual numbers of fish in parentheses).

Month	Beach seine		Otter trawl	
	North	South	North	South
January	5.0 (2/40)	--	3.1 (2/64)	10.5 (4/38)
February	--	32.0 (8/25)	NO SAMPLING	
March	NO SAMPLING		3.8 (2/52)	0.0 (0/21)
April	--	3.6 (1/28)	0.0 (0/30)	0.0 (0/3)
May	0.0 (0/169)	--	1.5 (1/67)	2.3 (1/44)
June	--	0.0 (0/122)	0.0 (0/36)	0.0 (0/18)
July	0.0 (0/324)	--	3.1 (1/23)	0.0 (0/34)
August	--	0.0 (0/159)	3.7 (1/27)	0.0 (0/7)
September	3.4 (5/145)	--	0.0 (0/14)	0.0 (0/13)
October	--	16.6 (26/156)	10.3 (4/39)	0.0 (0/13)
November	13.0 (6/46)	--	0.0 (0/40)	11.1 (1/9)
December	6.4 (5/78)	--	0.0 (0/37)	0.0 (0/10)
Total No.	18/802	35/490	11/429	6/210
Percentage	2.2	7.1	2.6	2.8

Table 11. Distribution of AEN and EP tumors on individual Parophrys vetulus.

Month	AEN			EP		
	Eyed	Blind	Both	Eyed	Blind	Both
January	1	1	1	3	3	6
February	0	1	0	11	9	6
March	0	0	0	1	0	1
April	0	0	0	0	0	1
May	0	0	0	3	0	5
June	0	0	0	0	0	0
July	0	0	0	1	1	1
August	0	0	0	2	1	2
September	1	0	0	0	2	5
October	4	0	0	12	27	3
November	0	0	0	7	5	2
December	0	0	0	3	3	7
Total No.	6	2	1	43	51	39
Percent of total	66.0	22.0	12.0	33.0	38.0	29.0

Table 12. Number and percent incidence of Parophrys vetulus and Lepidopsetta bilineata infested with Philometra at West Point (beach seines and otter trawls combined).

Month	<u>P. vetulus</u>		<u>L. bilineata</u>	
	No.	Percent Incidence	No.	Percent Incidence
January	9/145	6.2	3/49	6.1
February	0/25	0.0	0/1	0.0
March	5/74	6.8	2/91	2.2
April	4/61	6.5	2/18	11.1
May	8/224	3.6	2/54	3.7
June	4/256	1.7	1/47	2.1
July	5/322	1.5	0/44	0.0
August	0/193	0.0	0/35	0.0
September	1/103	0.9	2/9	22.2
October	4/208	1.9	1/28	3.6
November	0/95	0.0	0/41	0.0
December	0/125	0.0	0/21	0.0
TOTAL	40/1831	2.2	13/438	2.9

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APPENDICES



Appendix 1. Scientific and common names of fishes collected in the Duwamish River during 1974

Scientific name	Common name
<i>Spirinchus thaleichthys</i>	longfin smelt
<i>Platichthys stellatus</i>	starry flounder
<i>Parophrys vetulus</i>	English sole
<i>Leptocottus armatus</i>	Pacific staghorn sculpin
<i>Lumpenus sagitta</i>	snake prickleback
<i>Microgadus proximus</i>	Pacific tomcod
<i>Lepidopsetta bilineata</i>	rock sole
<i>Psettichthys melanostictus</i>	sand sole
<i>Microstomus pacificus</i>	Dover sole
<i>Cymatogaster aggregata</i>	shiner perch
<i>Artedius fenestralis</i>	padded sculpin
<i>Rhacochilus vacca</i>	pileperch
<i>Clupea harengus</i>	Pacific herring
<i>Hydrolagus colliei</i>	ratfish
<i>Oncorhynchus tshawytscha</i>	chinook salmon
<i>Enophrys bison</i>	buffalo sculpin
<i>Gadus macrocephalus</i>	Pacific cod
<i>Theragra chalcogramma</i>	walleye pollock
<i>Lepidogobius lepidus</i>	bay goby
<i>Embiotoca lateralis</i>	striped seaperch
<i>Hexagrammus stelleri</i>	whitespotted greenling
<i>Hippoglossoides elassodon</i>	flathead sole
<i>Cottus asper</i>	prickly sculpin
<i>Squalus acanthias</i>	spiny dogfish
<i>Odontopysis trispinosa</i>	pygmy poacher
<i>Oncorhynchus kisutch</i>	coho salmon
<i>Catostomus macrocheilus</i>	largescale sucker
<i>Porichthys notatus</i>	plainfin midshipman
<i>Chitonotus pugetensis</i>	roughback sculpin

Appendix 2. Scientific and common names of species collected in the vicinity of West Point during 1974.

Scientific name	Common name
<i>Parophrys vetulus</i>	English sole
<i>Hydrolagus colliei</i>	ratfish
<i>Lepidopsetta bilineata</i>	rocksole
<i>Cymatogaster aggregata</i>	shiner perch
<i>Microgadus proximus</i>	Pacific tomcod
<i>Platichthys stellatus</i>	starry flounder
<i>Oncorhynchus gorbuscha</i>	pink salmon
<i>Microstomus pacificus</i>	Dover sole
<i>Leptocottus armatus</i>	Pacific staghorn sculpin
<i>Embiotoca lateralis</i>	striped seaperch
<i>Citharichthys sordidus</i>	Pacific sanddab
<i>Pleuronichthys coenosus</i>	C-0 sole
<i>Rhacochilus vacca</i>	pileperch
<i>Ronquilus jordani</i>	northern ronquil
<i>Psettichthys melanostictus</i>	sandsole
<i>Sebastes caurinus</i>	copper rockfish
<i>Gasterosteus aculeatus</i>	three-spine stickleback
<i>Iyopsetta exilis</i>	slender sole
<i>Xeneretmus triacanthus</i>	bluespotted poacher
<i>Aulorhynchus flavidus</i>	tube-snout
<i>Ammodytes hexapterus</i>	Pacific sand lance
<i>Oligocottus maculosus</i>	tidepool sculpin
<i>Chitonotus pugetensis</i>	roughback sculpin
<i>Glyptocephalus zachirus</i>	rex sole
<i>Sebastes auriculatus</i>	brown rockfish
<i>Agonus acipensarus</i>	sturgeon poacher
<i>Citharichthys stigmaeus</i>	speckled sanddab
<i>Apodichthys flavidus</i>	penpoint gunnel
<i>Lumpenus sagitta</i>	snake prickleback
<i>Lycodopsis pacifica</i>	blackbelly eelpout

Appendix 2, cont'd

Scientific name	Common name
<i>Odontopyxis trispinosa</i>	pygmy poacher
<i>Radulinus asprellus</i>	slim sculpin
<i>Pholis laeta</i>	crescent gunnel
<i>Syngnathus griseolineatus</i>	bay pipefish
<i>Artedius fenestralis</i>	padded sculpin
<i>Nautichthys oculofasciatus</i>	sailfin sculpin
<i>Asterotheca alascana</i>	gray starsnout
<i>Blepsias cirrhosus</i>	silverspotted sculpin
<i>Xeneretmus latifrons</i>	blacktip poacher
<i>Spirinchus thaleichthys</i>	longfin smelt
<i>Theragra chalcogramma</i>	walleye pollock
<i>Gadus macrocephalus</i>	Pacific cod
<i>Hemilepidotus hemilepidotus</i>	red Irish lord
<i>Asterotheca infraspinata</i>	spinycheek starsnout
<i>Rhamphocottus richardsoni</i>	grunt sculpin
<i>Agonopsis emmelone</i>	northern spearnose poacher
<i>Icelinus tenuis</i>	spotfin sculpin
<i>Icelinus borealis</i>	northern sculpin
<i>Porichthys notatus</i>	plainfin midshipman
<i>Clinocottus acuticeps</i>	sharpnose sculpin
<i>Hypomesus pretiosus</i>	surf smelt
<i>Brosmophycis marginata</i>	red brotula
<i>Scorpaenichthys marmoratus</i>	cabezon
<i>Radulinus boloides</i>	darter sculpin
<i>Merluccius productus</i>	Pacific hake
<i>Sebastes maliger</i>	quillback rockfish
<i>Clupea harengus</i>	Pacific herring
<i>Enophrys bison</i>	buffalo sculpin
<i>Myoxocephalus polyacanthocephalus</i>	great sculpin
<i>Squalus acanthias</i>	spiny dogfish

