Sechelt Inlet Fish Habitat Inventory

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ABSTRACT

An inventory describing fish habitat characteristics of intertidal foreshore in Sechelt Inlet was conducted in order to provide a basis for review of marine development proposals in the area. Intertidal zones were surveyed visually from boats and by divers familiar with local marine vegetation. The inventory describes one hundred and twenty-six reaches within the Inlet based on composition of the substrate and the presence of marine vegetation.

Importance of fish habitat provided by Sechelt Inlet is further defined by analysis of epibenthic invertebrate samples collected over representative substrates (mud, sand, gravel/cobble and rock), and presentation of salmon escapement, herring spawn and shellfish production and harvest data. In addition, human use of the Inlet is described by foreshore/upland use information collected during the survey and on record with the Provincial Ministry of Lands, Parks and Housing.

Recommendations for management of the highly productive fish habitat provided by the Inlet are considered in the light of increasing development pressure along the whole of the Sunshine Coast.

L.R. Russell

RÉSUMÉ

On a effectué un inventaire descriptif des caractéristiques de l'habitat du poisson dans l'estran intertidal de l'inlet Sechelt afin de fournir une base pour l'examen des projets de développement du milieu marin dans cette région. Un relevé visuel des zones intertidales a été mené à partir de bateaux et par des plongeurs connaissant bien la végétation marine locale. L'inventaire décrit 124 secteurs de l'inlet sur la base de la composition du substrat et de la présence de végétation marine.

L'importance de l'habitat ichtyocole que constitue l'inlet Sechelt est soulignée par l'analyse des échantillons d'invertébrés épibenthiques recueillis sur des substrats représentatifs (vase, sable, gravier/pavé et roche) et les données sur la remonte de saumons, la fraie du hareng et la production et l'exploitation de coquillages. De plus, de l'information recueillie au cours du relevé et dans les documents du ministère provincial des terres, parcs et logement décrit l'utilisation que font les hommes de l'estran et du haut-pays.

Les recommandations relatives à la gestion de l'habitat ichtyocole très productif que constitue l'inlet sont étudiées, compte tenu de la pression croissante du développement sur toute la côte Sunshine.

ACKNOWLEDGEMENTS

The authors acknowledge the assistance of Fishery Officers Randy Tancock and John Lewis, and Conservation Officer Jamie Stephens, whose local knowledge and technical abilities assured accurate recording of fish habitat data during the study.

Don van der Horst, Senior Planner, Lower Mainland Region, Lands Parks and Housing, kindly provided the information on foreshore leases in Sechelt Inlet.

Val Rogers and Shelley Moxley prepared, typed and edited the Tables and text of the report.

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1.0 Introduction

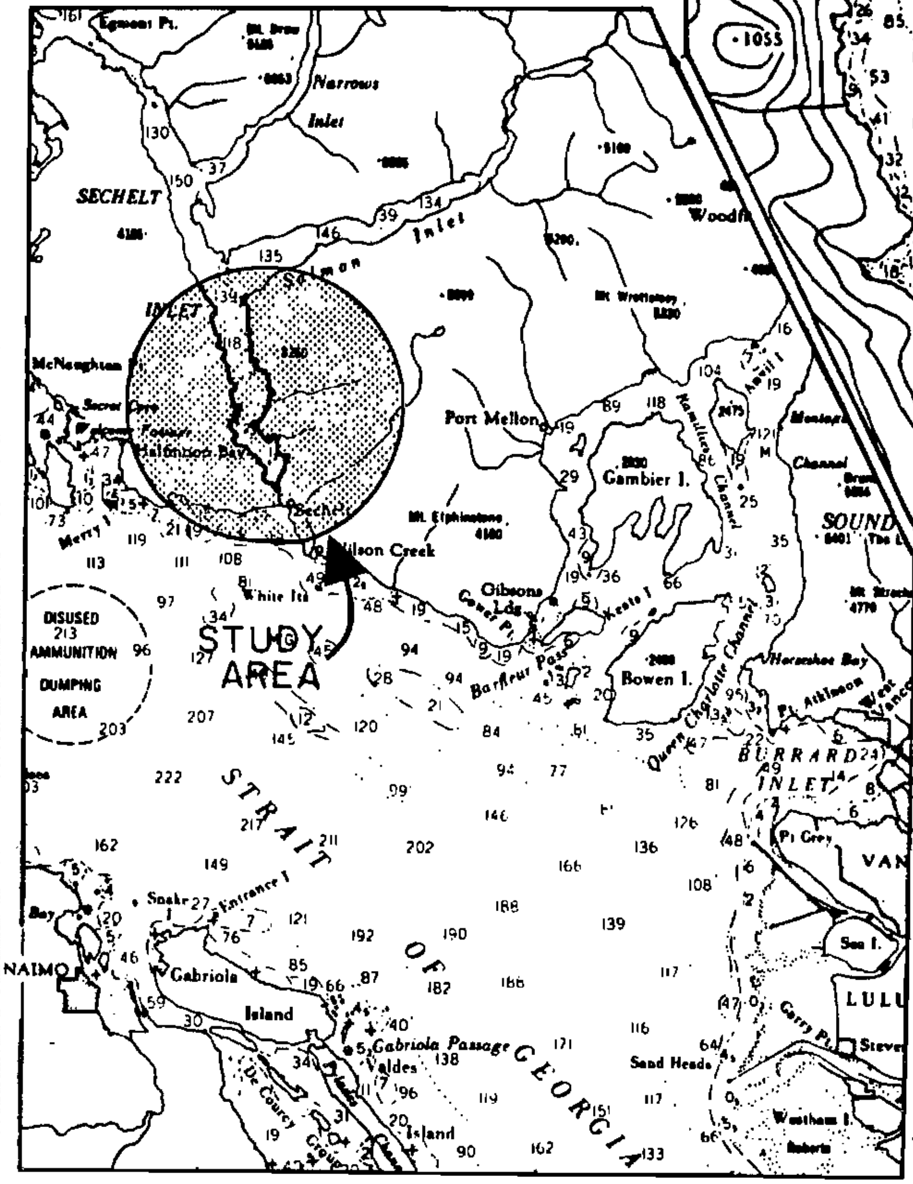
Sechelt Inlet is located immediately north of the Town of Sechelt, B.C. on the Sunshine Coast. Although much of the Inlet is rocky and steep with little intertidal fish habitat, the southern part of the Inlet, Porpoise Bay, is shallow and supports a large area of intertidal marsh, (Figure 1). Because of its proximity to the Village of Sechelt, Porpoise Bay is heavily used by local inhabitants and summer visitors as a recreation area. Accordingly, development pressure around the bay is heavy and continues to increase.

The Department of Fisheries and Oceans is responsible for reviewing all development proposals which potentially affect fish habitat in Sechelt Inlet. The Fishery Officer in charge, Pender Harbour, requested Habitat Management's assistance in conducting a fish habitat inventory of the area in order that an assessment of the effects of current development of the foreshore could be used as an indicator of potential effects of developments taking place in the future. It is our intent to present current information on substrate, vegetation, fish use, benthic fish food and foreshore use in Sechelt Inlet. This information should ensure that the Department fulfills its mandate by preserving and protecting the valuable fish habitat which presently exists within the Inlet.

2.0 Inventory Methods/Information Sources

Fish habitat charactertistics in Porpoise Bay were assessed by South Coast Division Department of Fisheries and Oceans staff using a small boat to follow the shallow reaches of shoreline around the Inlet. Substrate, vegetation and foreshore use in the bay were noted visually and recorded on 1:10,000 scale charts. Divers, using S.C.U.B.A., assessed vegetation and substrate in opaque or deep water although habitat characteristics are intended to be representative of intertidal and shallow subtidal areas (-10 ft.) only.

Benthic invertebrates were collected from four representative substrate areas (silt/mud, gravel/cobble, sand and bedrock) by S.C.U.B.A. divers using a Galen suction sampler. Three replicate samples were taken at each of four sites on two occasions, May 3 and August 12, 1983. The sampler was operated for a period of one minute, then samples were brought to the boat and strained through 253 micron mesh into a preserving jar where they were fixed in 60% isopropanol and stained with Rose Bengal. Samples were sent to a consultant for sorting and identification to Family level.



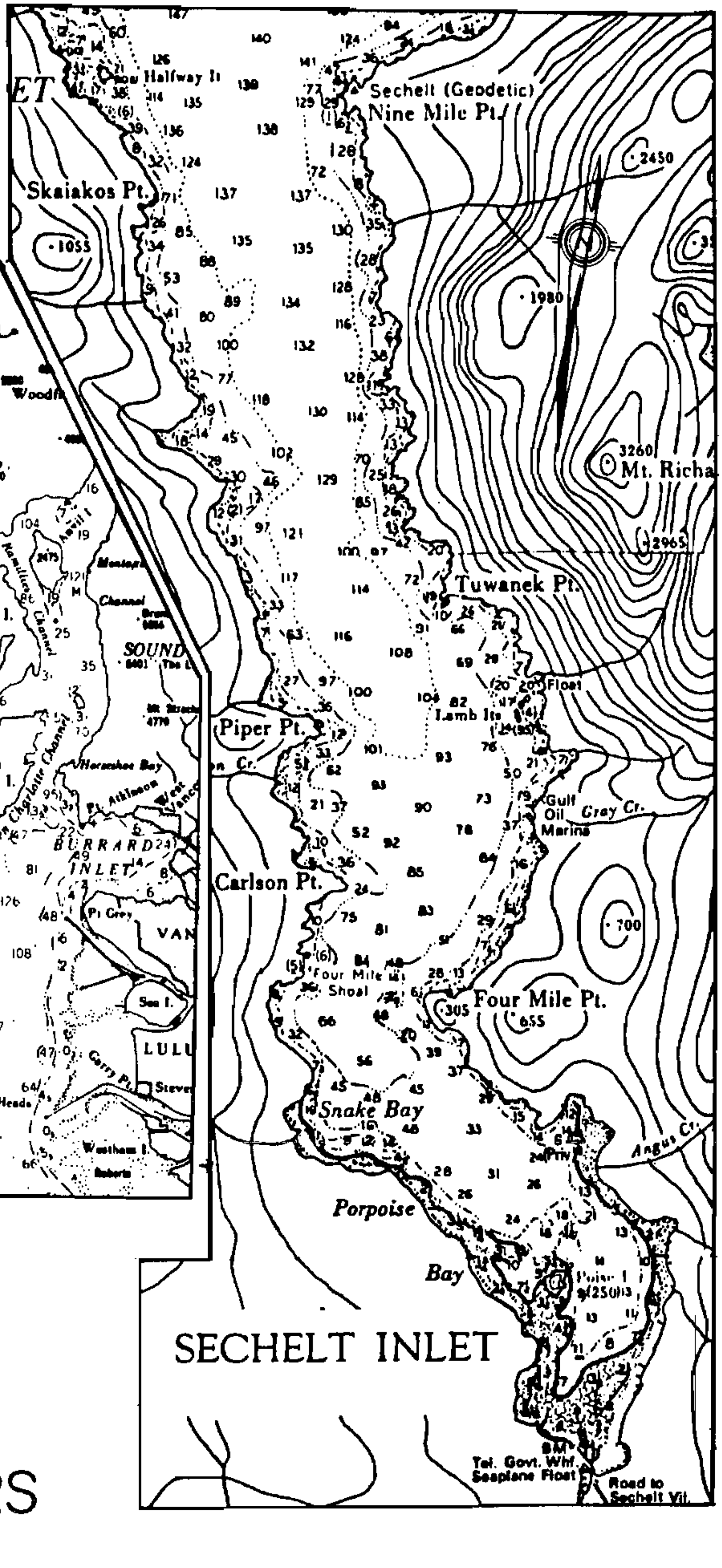


FIGURE I
SITE LOCATION
DEPTH CONTOURS

Utilization of Sechelt Inlet by salmon, herring and shellfish has been documented by Fishery Officers and management biologists for more than fifty years. Information contained in stream catalogues and spawning files was summarized and presented in tabular form. Recent information regarding fish and shellfish presence in Sechelt Inlet was obtained from the Fishery Officer in charge at Pender Harbour.

Foreshore use within Sechelt Inlet is reviewed and licensed by the British Columbia Ministry of Lands, Parks and Housing. Current use patterns of foreshore lots and status of upland development were obtained from the Senior Planner responsible for the Sunshine Coast, located at the Lands, Parks and Housing offices in Burnaby, B.C.

3.0 Physical Characteristics

For the purpose of this inventory, the physical characteristics of the foreshore region of Sechelt Inlet from Nine Mile Point around Porpoise Bay to Halfway Island have been delineated according to substrate composition from the High Water Line (HWL) to the visible upper subtidal.

3.1 Depth Contours

A chart depicting depth contours within Sechelt Inlet is given in Figure 1. Note that the majority of southern Porpoise Bay is shallow and that a significant proportion of the tip of the bay is intertidal. These shallow regions inevitably become conflict areas because they provide excellent habitat for juvenile fish and shellfish while at the same time affording easy to develop sites for industrial and recreational businesses.

3.2 Substrate Characteristics

Foreshore substrate characteristics for Sechelt Inlet are shown in Figure 2. For the purposes of this inventory, substrate material was classified into five categories.

B - bedrock or boulders
C - cobble
G - gravel
S - sand
M - mud/silt

The foreshore of Sechelt Inlet was divided into reaches based on substrate composition. In many instances, more than one category of material was present in each reach. In this case, the symbol for the dominant material was presented first,

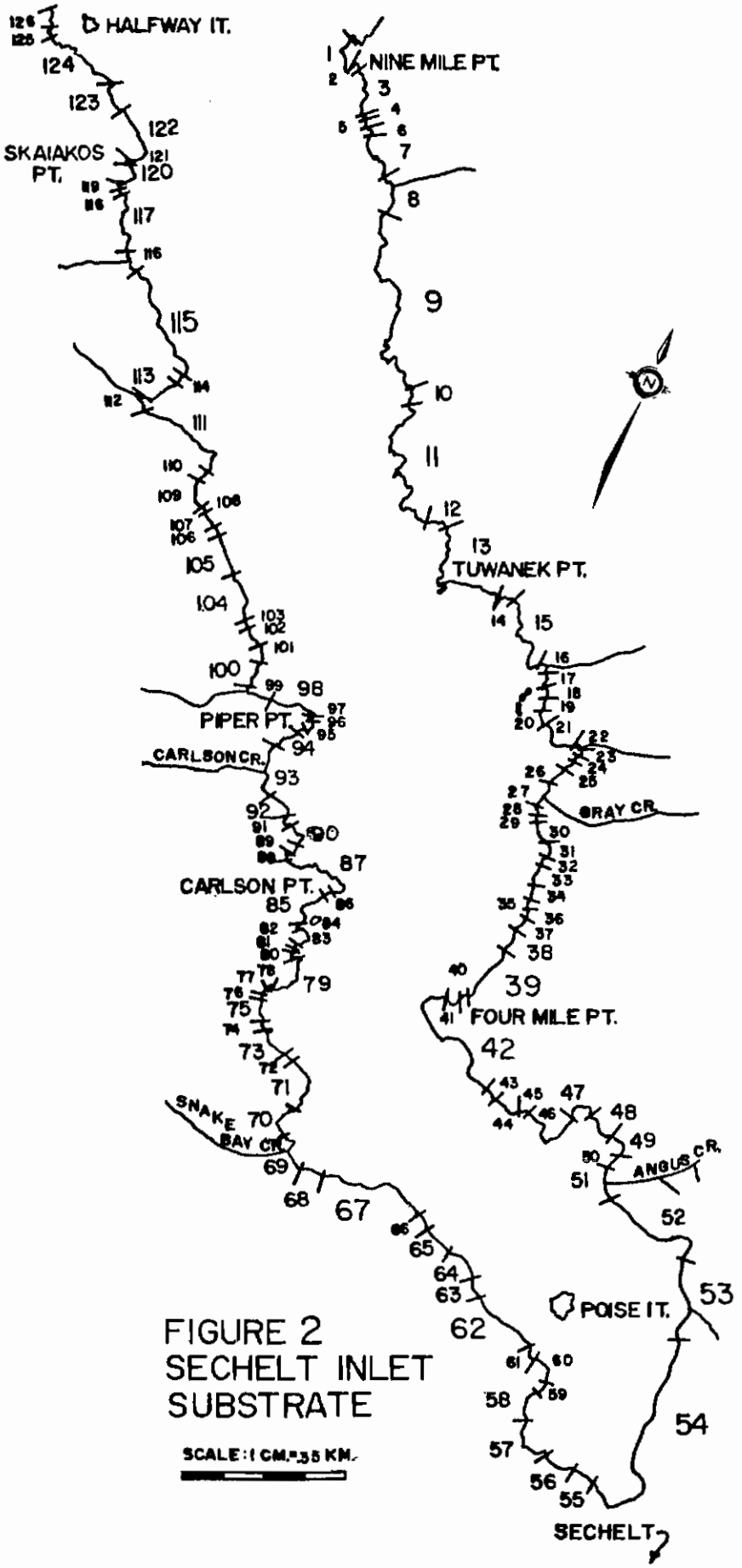


FIGURE 2
SECHELT INLET
SUBSTRATE

followed by the symbols for other substrate materials in the order of their importance. A new reach was defined whenever major changes in the substrate composition occurred (i.e. sandy foreshore was located adjacent to a reach of bedrock and boulders).

One hundred twenty-six substrate reaches are shown in Figure 2. The substrate compositon of each reach is given in Table 1. Bedrock was the dominant substrate in 65 reaches and was present in 74 of them. Sand was dominant in 24 reaches and present in 67. Gravel was dominant in 21 reaches and present in 47. Cobble was dominant in 11 reaches and present in 23. Mud dominated the substrate in 4 reaches out of 9 where it was present.

TABLE 1: Substrate Composition of Foreshore Reaches Defined in in Sechelt Inlet

B=Bedrock; C=Cobble; G=Gravel; S=Sand; M=Mud/Silt

Reach/Composition		Reach/Composition		Reach/Composition	
1	B	43	B,G	85	B
2	S,G	44	B	86	B,S
3	B	45	S,G	87	B
4	S,G	46	B	88	G,S
5	B	47	S,G,M	89	B,C
6	S,G	48	B	90	B
7	B	49	M,S,G	91	G,S
8	C,G,S	50	S	92	B,C
9	B	51	M,S,G	93	G,S
10	C,B	52	S,G,M	94	B,S
11	B	53	M,S,G	95	C,B
12	S,G	54	M,S	96	B
13	B	55	B,S	97	G,S
14	S	56	G,M	98	B
15	B	57	S,M	99	C,G,S,B
16	S,G	58	B	100	C,S
17	B	59	S,M	101	B,S
18	S,G,C	60	B	102	B
19	B,S	61	B,S	103	B,G,S
20	C,G,S	62	B	104	B,G
21	B	63	B,S	105	B
22	S,G	64	G,S	106	B,C
23	G,C	65	S,R	107	G,C
24	B	66	S,C	108	B
25	B,C	67	S	109	G,C
26	G,S,C	68	S,B	110	B,C
27	C,G,S	69	S	111	B
28	G,S	70	B,S	112	G,S,B
29	C,B	71	B	113	B
30	G,S	72	B,G	114	S
31	B,S	73	B	115	B
32	B	74	C,S	116	G,S
33	B,C,S	75	B	117	B
34	S,G	76	B,S	118	G,S,B
35	C,B	77	B	119	G,S
36	G,S	78	B,S	120	B
37	C,S	79	B	121	G,S
38	S,G	80	G,S	122	B
39	B,S	81	B	123	G,S
40	B	82	G,S	124	B
41	S,G,B	83	B	125	S,G
42	B	84	G,S	126	B

4.0 Biological Characteristics

Biological characteristics of the foreshore region of Sechelt Inlet were recorded over the same area as noted under Section 3.0, Physical Characteristics.

4.1 Vegetation

One hundred and seven vegetation zones were defined by the crew assessing foreshore values in Sechelt Inlet (Figure 3). Vegetation was divided into the following categories:

	Density
E - eelgrass	
R - rockweed	
K - kelp (bull, giant)	1 - sparse
M - marsh	2 - moderate
J - japweed	3 - dense
U - ulva	
B - brown algae	
G - green algae	NV - no vegetation
L - laminaria	

The vegetation composition for each reach is given in Table 2. Of the 107 vegetation zones, eelgrass was dominant in 39 and present in 57; rockweed dominated in 29 and was present in 50; kelp was dominant in 9 zones and present in 41; brown algae was seen in 22 zones and dominant in 15; marsh dominated in 6 of 16 zones where it was recorded; green algae was dominant in 1 out of 16 zones where it was seen; japweed dominated 4 out of 10 zones where is was present and ulva and laminaria were recorded at 2 locations each.

From the above, it is evident that eelgrass and rockweed are the most abundant vegetation types in Sechelt Inlet. However, since rockweed grows in a restricted zone on rock in the high intertidal, it provides relatively limited habitat for fish and fish food organisms. Eelgrass, on the other hand, is normally found in shallow, sheltered areas at tidal elevations of +2 to -6 ft. and may provide extensive bands of shelter and substrate for food producing organisms important to fish.

Marsh vegetation also represents good fish habitat and is found throughout the head of Porpoise Bay. Although marshes become dry at low tide, they are used by feeding fry throughout the periods when they are wetted. Out of the total length of foreshore surveyed (36.7 km), eelgrass and marsh vegetation was present in reaches whose total length extended more than 17.9 km. This represents a significant nursery area for juvenile fish and shellfish in Sechelt Inlet and is no doubt instrumental in the production of salmon in the Sechelt area.

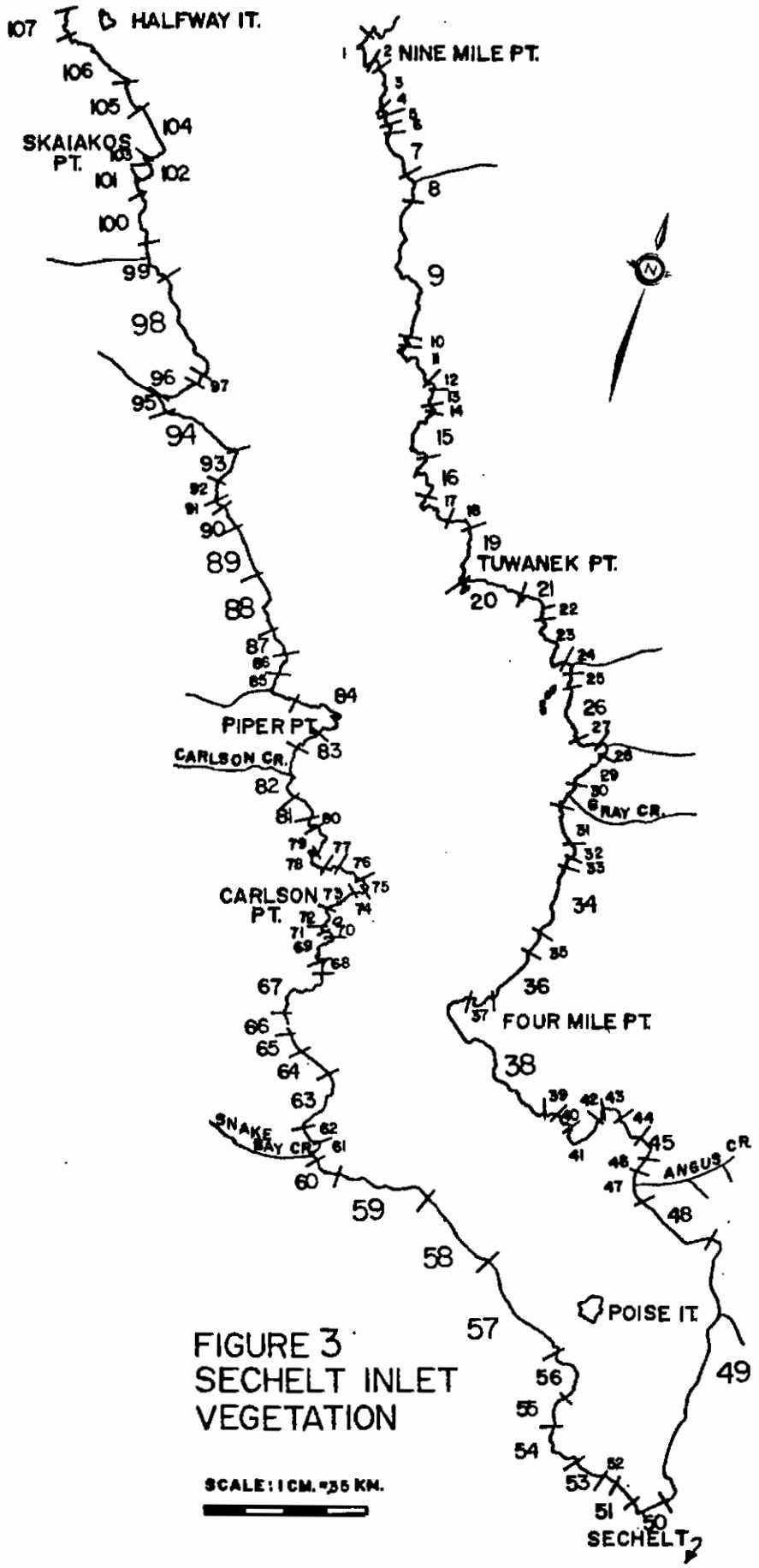


FIGURE 3
SECHELT INLET
VEGETATION

SCALE: 1 CM. = 3.5 KM.

TABLE 2: Vegetation Composition of Foreshore Reaches Defined in Sechelt Inlet

E=Eelgrass; R=Rockweed; K=Kelp; M=Marsh; J=Japweed; U=Ulva; B=Brown Algae; G=Green Algae; L=Laminaria; NV=No Vegetation
Density 1=Sparse; 2=Moderate; 3=Dense

Reach	Composition	Reach	Composition	Reach	Composition
1	R_2B_1	37	$E_2R_1K_1J_1M_2$	73	$B_1G_1E_1J_1K_1$
2	K_2E_1	38	R_2G_1	74	B_1K_1
3	R_1K_2	39	$R_1E_1U_1$	75	B_1
4	E_1R_2	40	R_2L_1	76	NV
5	R_2	41	R_2	77	E_1
6	E_1R_2	42	R_1	78	E_3
7	R_2	43	E_3	79	$B_2G_1E_2J_1$
8	$E_1R_2B_1$	44	R_2	80	E_3
9	R_2B_1	45	E_3	81	B_2E_1
10	$K_2R_2B_1$	46	E_3M_2	82	E_3M_2
11	R_2B_1	47	E_3M_3	83	$B_1E_2K_2$
12	K_2	48	$E_3M_1R_2$	84	B_2G_1
13	R_2	49	E_3M_3	85	E_3M_1
14	K_2	50	M_2	86	$B_1J_2K_2$
15	R_1K_1	51	E_3	87	B_1K_1
16	$R_1K_2E_3$	52	E_1R_2	88	$B_1G_1K_2$
17	R_1K_3	53	E_1	89	$B_1G_1L_2K_1$
18	E_3K_3	54	M_3E_1	90	E_3
19	R_1K_3	55	R_2	91	K_2
20	R_2	56	J_2E_3	92	$J_2K_2E_3$
21	$E_1R_1K_3$	57	E_1	93	$K_2R_1G_1$
22	E_2	58	E_3	94	$R_2G_2K_2$
23	R_1K_1	59	E_2	95	M_2E_2
24	E_2M_2	60	E_3	96	R_2G_1
25	$R_1E_1K_1$	61	M_3	97	E_2
26	R_1E_2	62	E_3	98	$J_2R_2G_1K_2$
27	R_1K_1	63	K_2R_2	99	$J_3R_2M_1K_2$
28	$M_1E_3R_1$	64	$B_1G_1J_1$	100	$G_1R_1K_2$
29	$R_1E_1K_2$	65	NV	101	$E_1K_2R_1$
30	M_1E_1	66	$E_2B_2G_1$	102	K_2R_1
31	K_1R_1	67	B_1G_1	103	$R_1E_1K_2$
32	E_2	68	E_2	104	$J_2K_2R_2U_1$
33	R_1	69	$B_1E_2K_1$	105	$E_2B_2M_1$
34	E_1R_1	70	NV	106	R_2K_2
35	$E_1R_1K_1$	71	$B_1G_1E_2$	107	E_2
36	$E_2R_1K_1$	72	B_2G_1		

Large kelps, brown and green algae and japweed were also present in many locations throughout the Inlet. These represent important herring spawn and juvenile salmon feeding areas.

4.2 Benthic Invertebrates

Analysis of benthic organisms collected in May and August, 1983 resulted in preparation of Figure 4. For simplicity, the data includes potential fish food organisms only. More detailed presentation of complete benthic analysis is given in Appendix I and II.

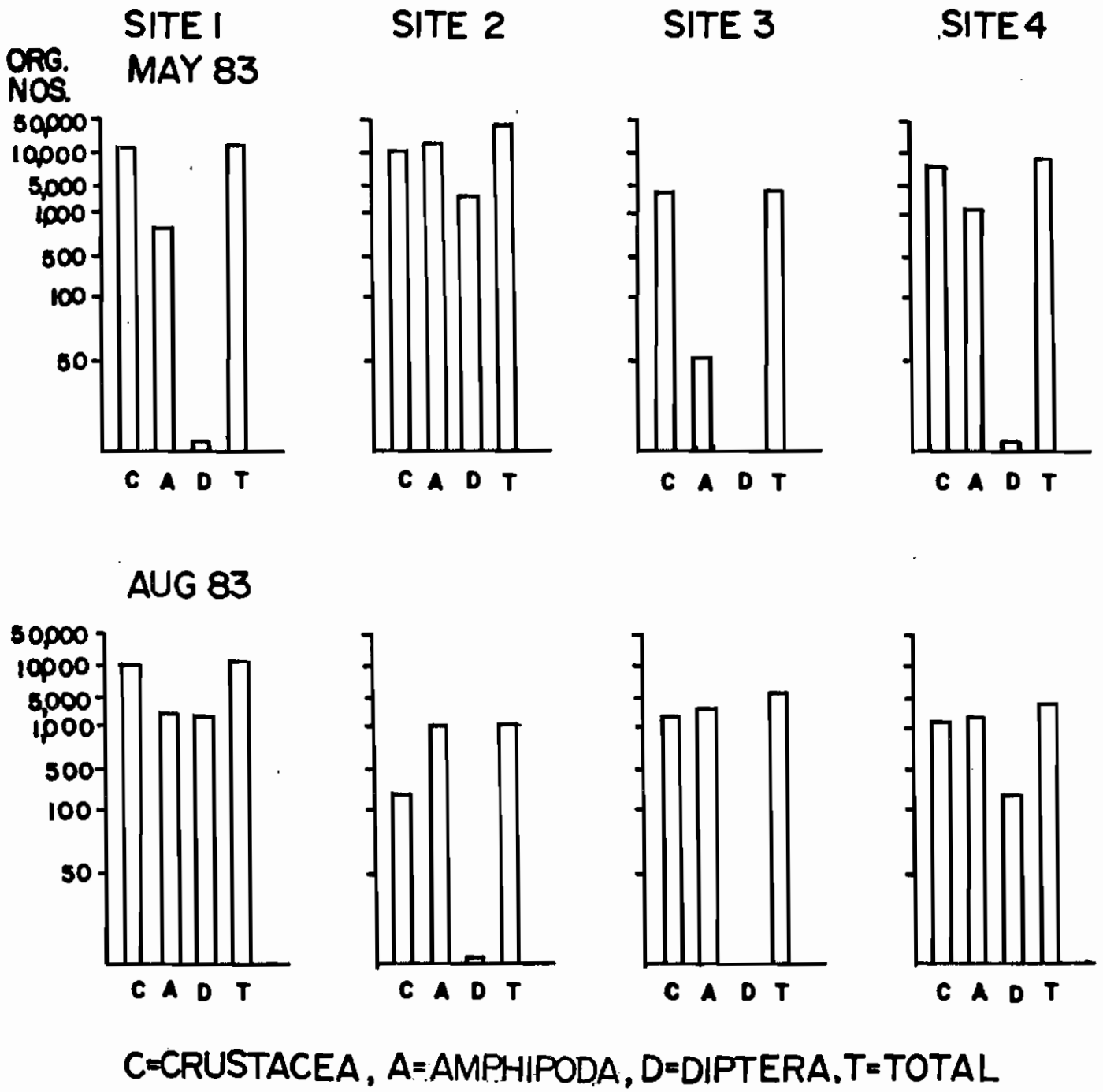
According to Figure 4, crustacea were the most abundant animals found overall. An average of 8,194 per m^2 were found during the sampling.

The greatest numbers of crustacea per m^2 were found at site 1 in a mud substrate (16,636). Gravel substrates (site 2) were next in importance with 8,220 per m^2, followed by rock (site 4) with 4,836 per m^2 and sand (site 3) with 3,086 per m^2. More crustacea were counted in May (11,903 per m^2) than August (4,485 per m^2).

Amphipods were the next most abundant organisms collected averaging 4,661 animals per m^2 overall. They were present in greatest numbers in gravel substrates (13,026 per m^2) followed by rock (1,931 per m^2), mud (1,855 per m^2) and sand (1,832 per m^2). Greater average numbers of amphipods were caught in May 6,836 per m^2) than in August (2,485 per m^2).

Diptera were the least abundant fish food organisms collected in Porpoise Bay in 1983 (713 per m^2). They were present in moderate numbers in both gravel and mud substrates (1,563 and 1,177 animals per m^2 respectively), however, only 111 animals per m^2 were collected on rock substrates and none were counted in sand. More diptera overall were collected in May than in August (average of 783 per m^2 vs 643 per m^2).

The above summary indicates that mud and gravel substrates yielded the majority of fish food organisms produced in Porpoise Bay. Together, these substrates accounted for 78% of the benthic animals collected. Table 1, which describes substrate composition in the inlet, indicates that mud or gravel was present in 50 of the 126 substrate reaches defined. These reaches account for 10.7 km or 20% of the foreshore surveyed and probably make a significant contribution to fish production in Sechelt Inlet.



C=CRUSTACEA, A=AMPHIPODA, D=DIPTERA, T=TOTAL

FIGURE 4 ABUNDANCE OF BENTHIC ORGANISMS (#/m²) IN SECHELT INLET, 1983. (FISH DIET ITEMS ONLY)

4.3 Salmon

In Sechelt Inlet, spawning salmon have been recorded in Angus, Gray, Carlson, Burnett and Snake Bay Creeks. A graph summarizing these escapements is given in Figures 5 and 6. Recent (1984) escapements to these creeks were:

	Angus*	Gray	Carlson*	Burnett*	Snake Bay*
Chum	3,000	150	600	350	1,500
Coho	225			25	
Chinook	30				

*Influenced by hatchery in Porpoise Bay

In addition to spawning salmon, rearing or migrating salmon also use the Inlet. All five species of salmon have been recorded in the area from time to time and make extensive use of the intertidal foreshore areas as feeding zones when they are juveniles.

4.4 Herring

Use of Sechelt Inlet by spawning herring has been recorded since 1942 (Hourston, 1980). Historically, time of initiation of spawn has occurred as early as February 12 and completion of spawn has occurred as late as April 27. Average spawn duration in recorded history is March 21 to April 6 with 170 billion eggs being deposited (Hourston and Haist, 1981).

More recently (1974-1982) only minor spawnings have been recorded in Sechelt Inlet. These have been recorded in Porpoise Bay, principally on eelgrass and marsh vegetation at the extreme southern tip of the bay (Figure 7). The abundance of eelgrass and other suitable spawning substrate in Porpoise Bay suggests that large spawns could be easily accommodated, should the fish choose to use the area in the future.

4.5 Shellfish/Crustaceans

Use of Sechelt Inlet by shellfish and crustaceans has not been well documented. However, on-site inspections of muddy and sandy inter and subtidal foreshore areas by DFO S.C.U.B.A. divers have revealed some significant clam beds and, at times, numerous dungeness and rock crabs. In addition, several crab fishermen maintain pots in Porpoise Bay.

The above information suggests that the head of Sechelt Inlet affords good habitat for growing shellfish.

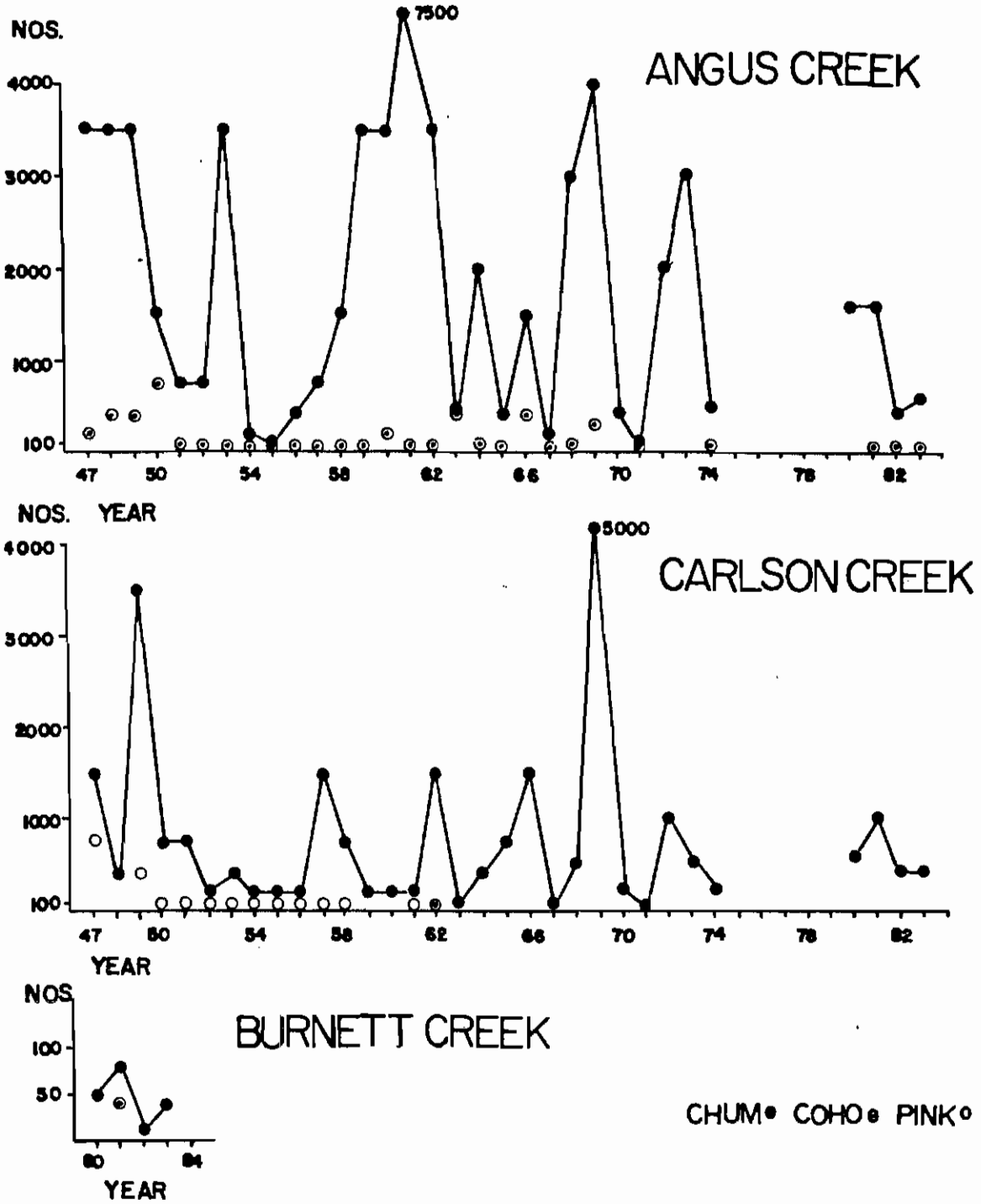


FIGURE 5 SALMON ESCAPEMENTS VS. YEAR

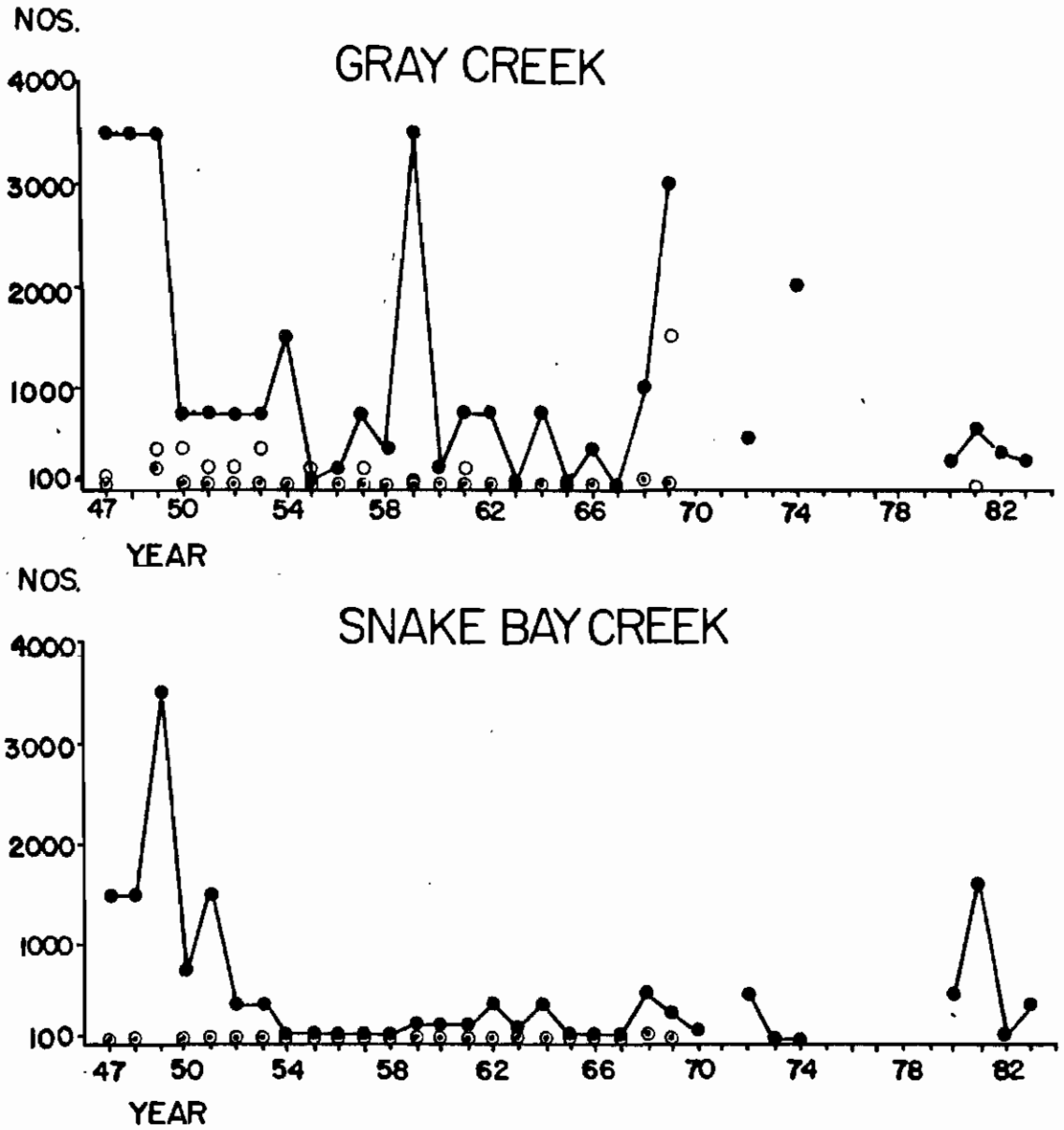


FIGURE 6 SALMON ESCAPEMENTS VS. YEAR

CHUM • COHO • PINK ○

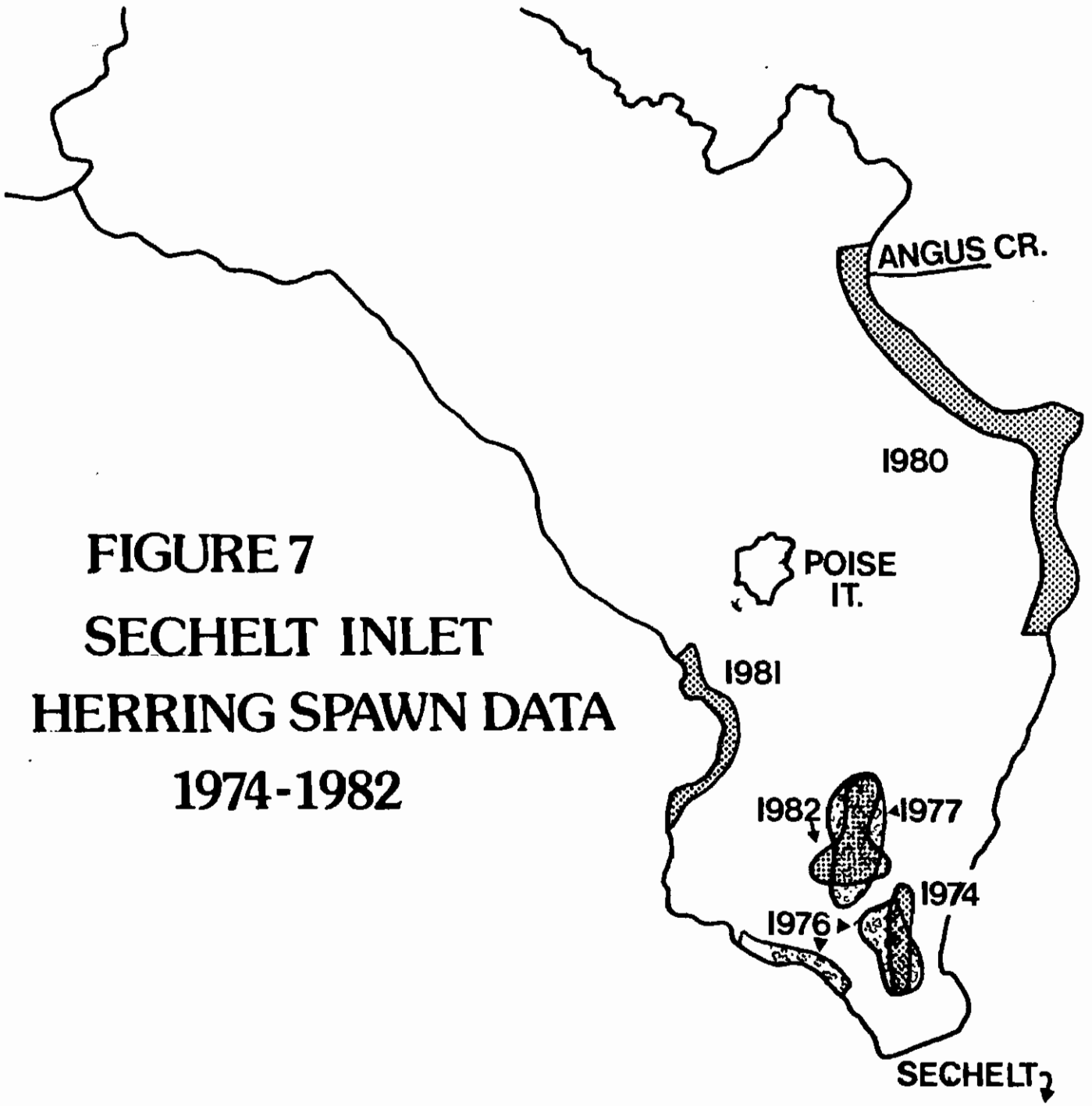


FIGURE 7
SECHELT INLET
HERRING SPAWN DATA
1974-1982

5.0 Foreshore Use

Current foreshore use within Sechelt Inlet south of a line drawn between Halfway Island and Nine Mile Point was assessed from a boat and through records provided by the Ministry of Lands, Parks and Housing.

The boat survey recorded human use of the Inlet on a chart of the area (Figure 8) using the symbols noted below:

C - commercial (hotels, restaurants, boat repair)
D - private moorage, docks, floats
M - marinas
F - fuel station
BL - barge loading area
LB - log boom
LD - log dump
LS - log sort
FP - fish pen-rearing (salmon)
G - gravel pit
FL - float plane dock
B - breakwater
LR - launch ramp
P - park
O - oyster lease

Foreshore lease locations are shown in Figure 9. This figure shows that a large proportion of the foreshore of Sechelt Inlet is currently under lease (approximately 7.6 km of the 36.7 km of shoreline available). Of the 28 currently active leases, 6 are used for log storage or handling, 11 are used for aquaculture, 6 are used for commercial marinas, one is used as a gravel operation, and the rest are used for private moorage.

A list of the leases and the purpose for which they have been licensed is given in Table 3.

6.0 Consideration of Potential Foreshore Development within Sechelt Inlet

Sechelt Inlet is under increasing pressure from commercial, industrial and private developers. Since decentralizaion of habitat management staff occurred in 1982, four major commercial proposals and numerous aquaculture and private moorage applications involving the Inlet have been reviewed. Industrial use of the Inlet for gravel and log handling purposes has continued to occur. The local Fishery Officers in Pender Harbour deal with numerous referrals and complaints regarding foreshore use in Sechelt Inlet and have suggested that any positive shift in the British Columbia economy may result in significant development pressure in the area in future.

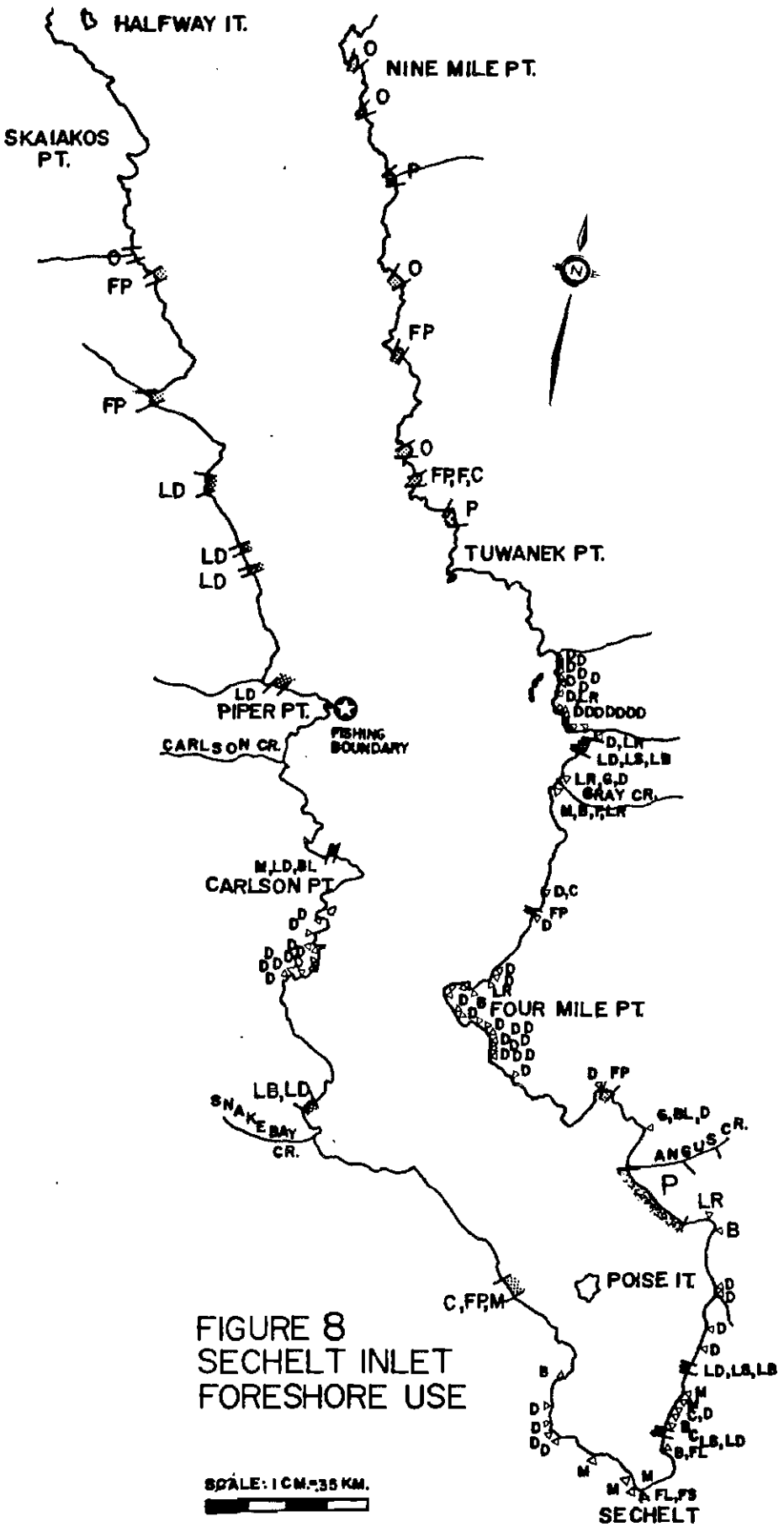


FIGURE 8
SECHELT INLET
FORESHORE USE

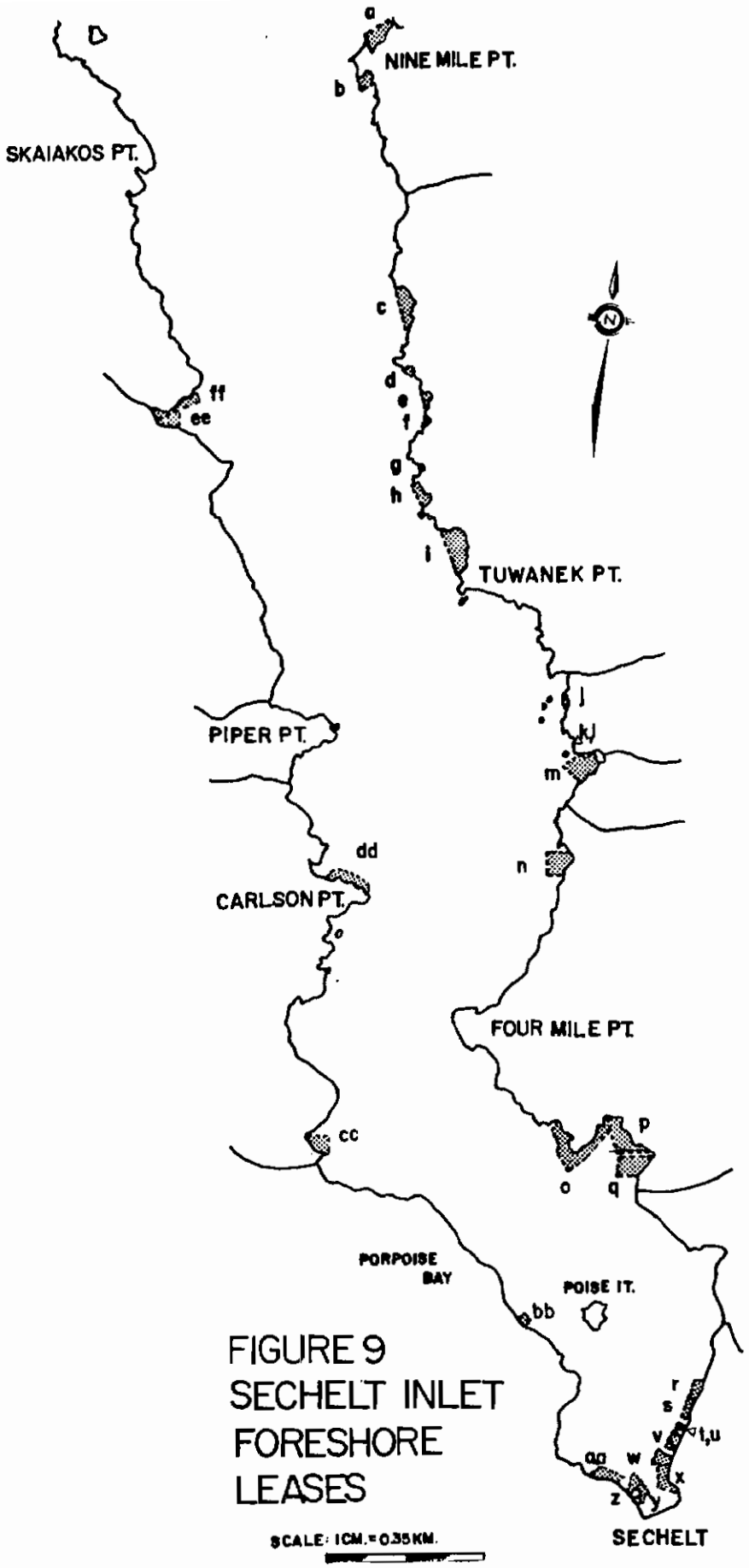


FIGURE 9
SECHELT INLET
FORESHORE
LEASES

The following is an evaluation of fish habitat and fisheries concerns relating the data collected in this study to future foreshore development of the Inlet.

Table 3: Foreshore Leases within Sechelt Inlet - 1984

a	File - 2401019	- Aquaculture
b	File - 2400811	- Aquaculture
c	File - 2401373	- Aquaculture
d	File - 2401526	- Aquaculture
e	File - 0348597	- Aquaculture
f	File - 2401527	- Aquaculture
g	File - 2400422	- Aquaculture
h	File - 0325827	- Lot 3872 - Aquaculture
i		Lot 6992 - Aquaculture
j	File - 2400895	- Private Moorage
k	File - 2400410	- Private Moorage
l	File - 2400474	- Private Moorage
m	File - 0162895	- Lot 5992 - Log Dump
n	File - 0219894	- Lot 6855 - Marina
o		Lot 6850 - Expired
p	File - 2400303	- Lot 5982 - Aquaculture
q	File - 0288503	- Lots 2377, 1557 Industrial
r		Lot 5898 - Expired
s		Lot 7107 - Log Sort
t		Marina
u		Lot 6798 - Marina
v	File - 0170680	- Lot 6065 - Log Storage
w		Lot 6837 - Expired
x		Lot 6022 - Expired
y	File - 0248665	- Lot 7066 - Marina
z	File - 0195421	- Lot 6241 - Private Moorage
aa	File - 0324739	- Lot 3601 - Marina
bb	File - 0301173	- Lot 3139 - Marina
cc	File - 2400098	- Industrial
dd	File - 2400823	- Log Handling
ee	File - 0354387	- Aquaculture
ff	File - 2401283	- Log Storage

6.1 Habitat Evaluation

As noted in earlier sections describing substrate and benthic invertebrates, nearly a third of Sechelt Inlet contains gravel or mud substrates which have been shown to contain large quantities of fish diet items. Vegetation mapping (Figure 3) illustrates the extensive plant cover which is present over much of the intertidal zone of the Inlet. Eelgrass beds and intertidal salt marshes provide excellent cover and substrate for animals which become prey for juvenile fish and provide spawning areas for herring and resting/feeding zones for many species of fish and shellfish, including salmon. Eelgrass and marsh vegetation was present in survey reaches which together total nearly 49% of the overall shoreline length afforded by the Inlet. Although these forms of vegetation do not cover the full width of each reach in many cases, their contribution to the total fish habitat assembly is still significant. The densest concentrations of eelgrass/marsh occur in Porpoise Bay; coincidentally the area under greatest pressure from developers.

The other kelps and algaes identified in the vegetation survey also provide valuable fish habitat, particularly as regards protection of small fish from predators and spawning substrate for herring. S.C.U.B.A. surveys of vegetated areas recorded numerous rockfish, greenling, juvenile herring and shellfish. Observation of shallow foreshores in the spring also noted several schools of juvenile salmon moving and feeding throughout zones of emergent vegetation.

6.2 Fisheries Concerns

Despite the above description of fish habitat values in Sechelt Inlet, D.F.O. has some serious concerns regarding foreshore development in the area. Foreshore leases cover nearly one fifth of the nearshore intertidal zone in the Inlet. While many of these leases are private or for aquacultural purposes, the Village of Sechelt has zoned much of the foreshore in Porpoise Bay "commercial" and as such is encouraging industry to develop in the Bay. In Porpoise Bay itself (defined by an imaginary line between Four Mile Point and a point north of Snake Bay), 26% of the foreshore is under lease, primarily to industry. Figure 8 shows that the Bay supports an aircraft company, 6 marinas, a marine repair facility, a gravel operation, 3 log handling leases, a hotel complex and numerous private moorage facilities. When these existing developments are considered together with potential future expansion of industry in Porpoise Bay, it is apparent that D.F.O.'s concerns about significant loss of valuable fish habitat in the Bay are well founded.

Although the most obvious area of concern in Sechelt Inlet is Porpoise Bay, several other areas within the Inlet may be adversely affected if the wrong kinds of industrial development occur. Numerous pocket beaches exist within small bays around the Inlet which afford sand and gravel substrate and support dense marsh/eelgrass or algae/kelp vegetations. These beaches are easily destroyed through careless operation of machinery or deposit of industrial wastes. Because they are relatively inaccessible except by water, they may be overlooked during the process of lease application and their value as small but important fish/shellfish nursery areas may be underestimated. In order that these pockets of prime habitat can continue to contribute to the fisheries resource in Sechelt Inlet, D.F.O. must continue to inspect each development application, no matter where or how small.

7.0 Recommendations

This inventory is intended as an overview or first reference when assessing the effects of development on fish habitat in Sechelt Inlet. Seasonal differences will result in variations in vegetative cover and/or fish/shellfish presence in each zone identified. Habitat may change within a zone or over several zones as developments occur or succession proceeds. The only sure way to assess an individual application is by individual on-site inspection.

Some general recommendations can, however, be made as a result of this study. D.F.O., Habitat Management's current policy of no net loss of valuable fish habitat ensures that no spawning, nursery or migration habitats frequented by fish will be developed unless the equivalent habitat is provided by the potential developer. In Sechelt Inlet, this policy suggests that no foreshore development of vegetated areas, in particular those with gravel/mud/sand substrates which produce large quantities of fish food organisms, should be developed unless the proponent of the project can ensure that all the fish habitat altered or destroyed will be replaced.

Some foreshore areas are unique and should not be developed for any reason. These include salt marshes together with their accompanying mudflats and eelgrass beds and pocket beaches along predominantly rocky foreshores where the presence of eelgrass beds represents essential unique refuge areas for fish and shellfish.

Wherever possible, foreshore development should be directed to areas of the Inlet where fish habitat concerns are minor. These areas include the bedrock foreshores with adjacent deep water characteristic of much of the northern part of the Inlet. In most instances, development of these areas will result

in the loss of only a narrow band of rockweed and some broad-leafed kelps and algaes. The loss of these vegetation types can be compensated through placement of shot rock reefs in water up to 30 feet deep where kelps such as Laminaria, Nereocystis and Macrocystis will establish themselves and provide new fish habitat.

8.0 References

Hourston, A.S. 1980. Timing of Herring Spawnings in British Columbia, 1942 - 1979. Can. Rep. Fish. Aquat. Sci. 118:101 p.

Hourston, A.S. and V. Haist. 1980. British Columbia Herring Spawn Deposition Data for 1981. Can. Rept. Fish. and Aquat. Sci. No. 317

APPENDIX I - Benthic Animals (Potential Fish Food) Sampled in Porpoise Bay in 1983 (#ORG/M^2)

	Site 1 (mud)	Site 2 (gravel)	Site 3 (sand)	Site 4 (rock)
May				
Crustacea	19,612	16,196	4,000	7,806
Amphipoda	820	24,700	52	1,772
Diptera	3	3,122		6
Total	20,435	44,018	4,052	9,584
August				
Crustacea	13,660	244	2,171	1,866
Amphipoda	2,890	1,351	3,611	2,089
Diptera	2,351	3		217
Total	18,901	1,598	5,782	4,172

APPENDIX II - Occurrence of Major Fish Food Organisms Sampled in Porpoise Bay Benthos, 1983

#organisms/m^2 (replicates averaged)

	Site 1 (mud)	Site 2 (gravel)	Site 3 (sand)	Site 4 (rock)
May, 1983				
Crustacea	98		195	
*Cladocera		390		
Ostracoda	5,171	12,879	1,805	488
*Harpacticoida	19,514	15,416	4,000	7,318
*Cyclopoida	98	390		390
*Calanoida				98
Cirripeda				6
Mysidacea				
Mysidae	3			
Cumacea	10,147	390	738	98
Tanaidacea		2,342		
Paratanaidae		5,552	3	832
Tanaidae	293	976		
Amphipoda				
*Ampithoidae	9	204		18
*Anisogammaridae	27			
Caprellidae		1,793	3,195	302
*Corophiidae	784	24,596	49	1,470
*Hyalidae				
*Pontogeneiidae			3	302
Arachneida				
Acari	1,463	2,927	732	2,537
Araneida		195		
Insecta				
Collembola	195			393
*Diptera Larva	3	3,122		3
*Diptera Pupa				3
Homoptera				

APPENDIX II - Occurrence of Major Fish Food Organisms Sampled in Porpoise Bay Benthos, 1983

#organisms/m^2 (replicates averaged)

	Site 1 (mud)	Site 2 (gravel)	Site 3 (sand)	Site 4 (rock)
August, 1983				
Crustacea				
*Cladocera				
Ostracoda	83,546	2,683	6,171	942
*Harpacticoida	13,660	244	2,171	1,531
*Cyclopoida				253
*Calanoida				82
Cirripeda				
Balanidae	180	637	3	98
Mysidacea				
Mysidae				
Cumacea			1,146	204
Tanaidacea				
Paratanaidae				570
Tanaidae	10,559	10,513	171	
Amphipoda			122	
*Ampithoidae	18	55	290	226
*Anisogammaridae	1,302			
Caprellidae			12	58
*Corophiidae	1,570	390	3,323	1,805
*Hyalidae		906		
*Pontogeneiidae				58
Arachneida				
Acari				
Araneida				
Insecta				
Collembola	6			
*Diptera Larva	2,348	3		217
*Diptera Pupa	3			
Homoptera		49		