ENVIRONMENTAL PROTECTION BRANCH
ENVIRONMENTAL PROTECTION SERVICE
PACIFIC REGION

PULP MILL ENVIRONMENTAL ASSESSMENT
CROWN ZELLERBACH
ELK FALLS MILL

Regional Program Report: 79-9

by

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ABSTRACT

In October 1976, the Environmental Protection Service initiated a program to assess the environmental impact of pulp and paper mills in British Columbia. With the co-operation of various other government agencies and the industry, EPS compiled relevant resource data and receiving environment monitoring information. After reviewing and evaluating the existing information, the environmental quality of each area was assessed and the need for additional monitoring studies determined. This report represents the environmental impact assessment for the Crown Zellerbach Canada Ltd., Elk Falls Mill.

RÉSUMÉ

Au mois d'octobre 1976, le Service de la protection de l'environnement a entrepris d'évaluer les répercussions mésologiques des fabriques de pâtes et papiers de la Colombie-Britannique. Aidé de l'industrie et de divers autres organismes gouvernementaux, il a réuni une documentation concernant les ressources ainsi que certains résultats de contrôles portant sur l'environnement affecté. Après avoir étudié ces données, le Service a évalué la qualite environnementale de chacune des régions et déterminé quelles seraient les études supplèmentaires qui resteraient a réaliser. Ce rapport fait connaitre les résultats ayant trait à l'évaluation des contrecoups imputables à la fabrique de pâte de la Crown Zellerbach Canada Ltd., Elk Falls Mill.

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SUMMARY AND CONCLUSIONS

The mill seems to be having little impact on the water quality of Discovery Passage, primarily due to its excellent flushing characteristics. The installation of a submarine diffuser has eliminated the presence of effluent from the surface waters.

Since the installation of the diffuser the main areas of benthic biological degradation appear to be directly adjacent to the diffuser itself and along the mill front, in close proximity to the mill.

A zone of influence in the intertidal zone had been present prior to the installation of the diffuser. Recovery in the intertidal zone has begun since the diffuser came on line.

Future monitoring programs should include water quality profiling of the entire water column, such that any unforeseen problems, below the effluent trapping level may be identified as they arise.

1 INTRODUCTION

The Crown Zellerbach Canada Ltd., Elk Falls pulp mill, is located on Duncan Bay, 6.5 km northwest of Campbell River at latitude 50°04.5'N by longitude 125°17'W. The mill is on the shores of Discovery Passage 8 km southeast of Seymour Narrows (Figure 1). Seymour Narrows and Discovery Passage are both subject to extremely strong tidal streams, making the location of the mill one of the most fortuitous on the coast with respect to water pollution considerations.

The climate of the Campbell River area is typical of the West Coast and is generally cooler and wetter than areas more southerly in the Strait of Georgia (Bell and Thompson, 1977). The annual mean daily temperature is 8.9°C ranging from 1.3°C in January to 17.4°C in July. The average monthly rainfall ranges from a low of 39 mm in July to a high of 231 mm and 270 mm in November and December respectively. The prevailing winds are from the northwest and southeast.

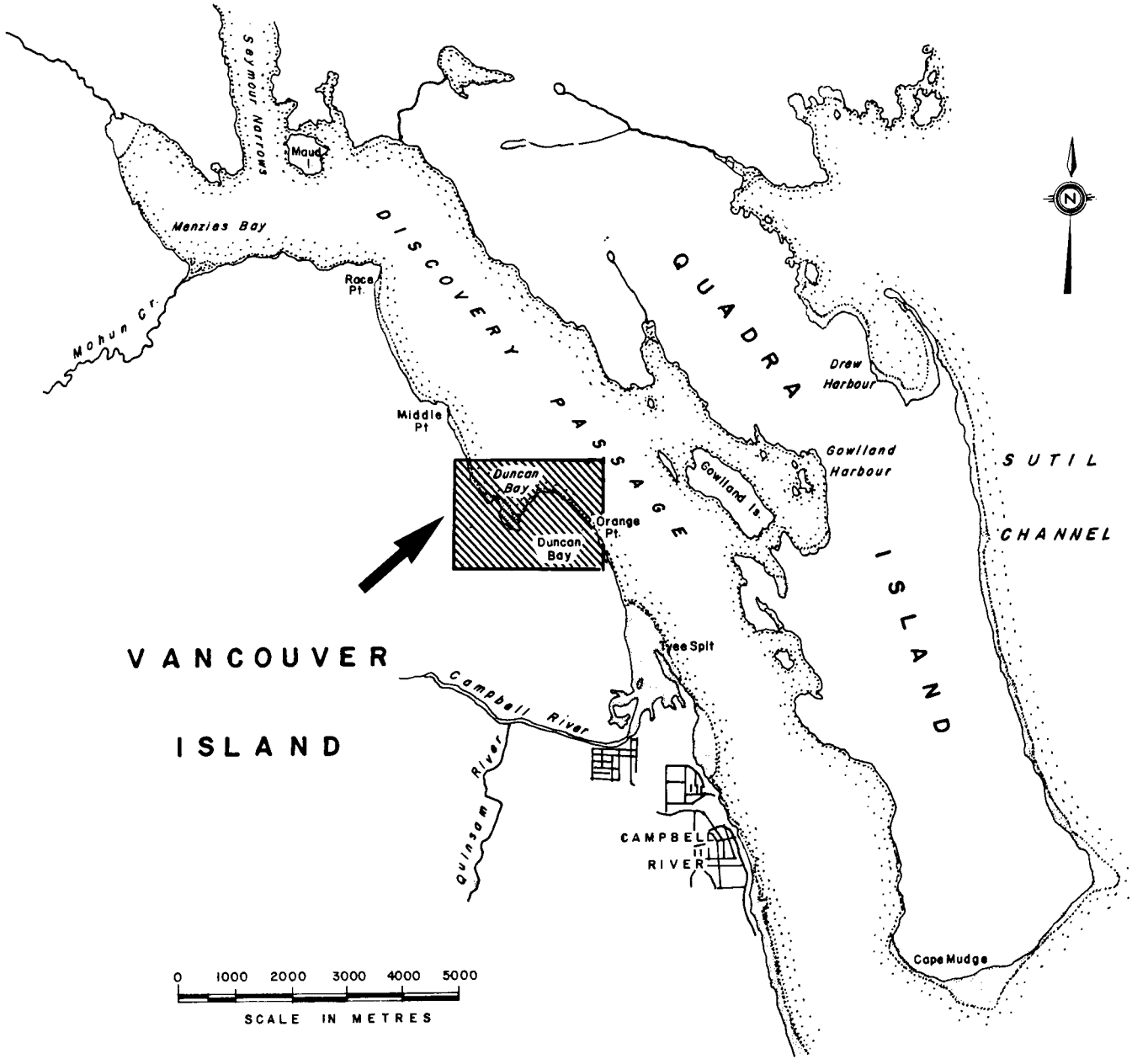

FIGURE 1 LOCATION MAP

2 MILL OPERATIONS

The mill was established in 1952, and has since undergone two expansions to achieve its present production level as outlined below:

TABLE 1 1978 PRODUCTION AVERAGES

Product	Production ADT
Groundwood Pulp	727
Kraft Pulp	564
Specialty Grade Multiproduct Pulp	239

2.1 Mill Processes

The current mill processes are outlined in reports by Ker, Priestman, Keenan and Associates (1970) and McLean and Tanner (1974) and are briefly summarized below:

Two methods of pulping are utilized at Elk Falls, groundwood and chemical pulping. Groundwood pulp is produced from blocks cut in the woodmill from hydraulically debarked logs. Chemical pulping is performed in a total of 11 digesters of four different types using wood chips, 85% of which are purchased externally.

Other processes at the mill complex include newsprint production, and a sawmill/planer mill.

2.2 Mill Discharge

Originally the effluents from the mill were discharged through four pipes located as shown in Figure 2, along the mill front, into Discovery Passage. A fifth discharge was also directed into Casey Creek to handle the overflow of lime mud from the recausticizing area. This discharge contributed to the degradation of water quality in Casey Creek.

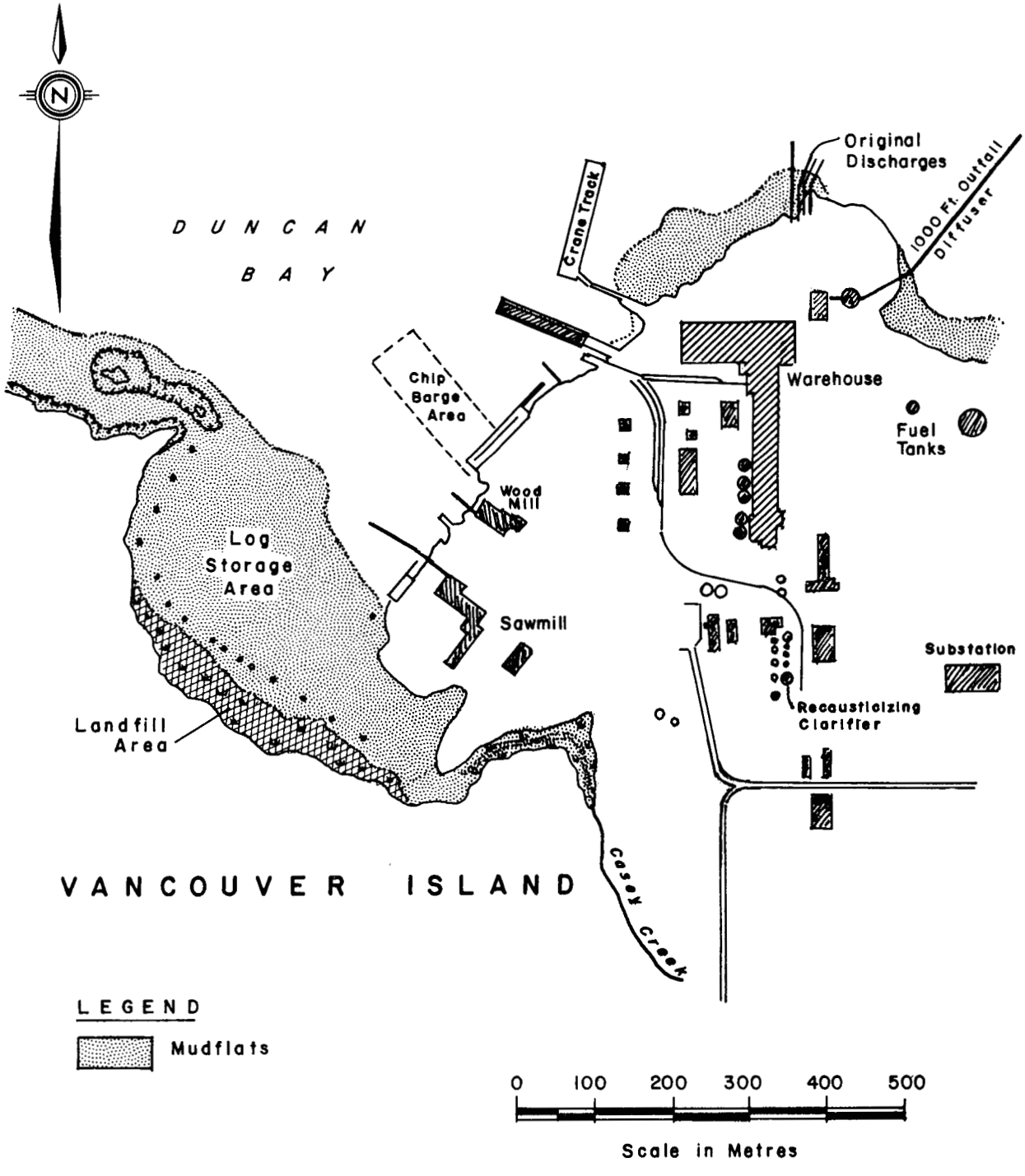

FIGURE 2 ELK FALLS PULPMILL LAYOUT

In January, 1977, all of the mill discharges were combined into one which discharges into Discovery Passage via a submarine diffuser (Figure 2) at a depth of 120-180 ft (37-55 m). Approximately concurrent with the installation of the new diffuser a new recausticizing clarifier to reduce suspended solids and a foam tower were installed.

All solid wastes generated by the mill complex are trucked to a landfill site as shown in Figure 2.

2.3 Effluent Treatment (McLean and Tanner, 1974)

2.3.1 Groundwood. Approximately 40% of the coarse screen rejects from the groundwood mill go to hogfuel. The remaining 60% pass through a shredder and are recycled back to the coarse screen stock chest. The secondary screen rejects are rerouted to the raw stock chest and the high consistency refiner system. This stock is introduced back into the system at the coarse screen stock chest.

2.3.2 No. 1 and No. 2 Paper Machines. The white water from these machines is both re-used and passed through a series of cleaning systems such that losses which averaged 5% of production in 1971, were reduced to 2.5% by 1974.

2.3.3 Flyash. Flyash is sluiced to a Tyroc vibrating screen. The separated material is re-cycled to hogfuel while the underflow goes to a flyash settling pond which achieves 80% suspended solids reduction.

2.3.4 Hydraulic Debarker Effluent. The hydraulic debarker effluent is treated with four Tyroc vibrating screens. The separated material goes to hogfuel while the underflow is reused in the block flume. The block flume effluent overflows to the Groundwood II and III sewers.

2.3.5 Miscellaneous Discharges. A dregs filter removes green liquor dregs from the recaust sewer. These are subsequently trucked to landfill. The lime mud is filtered and then trucked to landfill. Sewage is treated with an activated sludge treatment system prior to being discharged through the submarine diffuser.

2.3.6 Recausticizing Effluent. The recausticizing effluent is passed through a clarifier which became operational in 1977 resulting in substantially reduced suspended solids losses.

2.3.7 Effluent Diffuser. The entire mill effluent is discharged via a diffuser at a depth of 37-55 m in Discovery Passage. The diffuser is designed to provide an initial effluent dilution of 20:1.

3 EFFLUENT QUALITY

The Elk Falls pulp mill is authorized to discharge effluent under the terms of British Columbia Pollution Control Branch Permit No. PE-1164. This permit was first issued in 1973, and was amended June 5, 1978. The terms of the amended permit are outlined in Table 2. When the Federal Government Pulp and Paper Effluent Regulations (Environment Canada, 1971) are applied to the Elk Falls mill the company will be required to comply with effluent standards of biological oxygen demand (BOD_5), suspended solids (SS) and toxicity as shown in Table 3. The Federal requirements for SS are expressed as a given number of pounds per air dry ton (lb/ADT) of product and as such the allowable amount of material permitted to be deposited can change from day to day depending on the production rate of the mill. The terms of the amended PCB permit however, stipulate a maximum amount of material which may be deposited in a given day regardless of the production rate of the mill. As such it is difficult to compare the two requirements in terms of compliance.

The data contained in Tables 4 and 5 indicate a continued reduction in the quantity of SS released by the mill. The change between 1977 and 1978 SS values may be directly attributed to the installation of the recausticizing clarifier.

In December 1975, an effluent monitoring program was initiated by Fisheries and Environment Canada to determine the range of toxicity associated with pulp mill effluent. Elk Falls participated in this program by sending composite effluent samples to the EPS bioassay laboratory in Vancouver for toxicity testing. The results of this program are presented in Table 6.

TABLE 2 PROVINCIAL POLLUTION CONTROL BRANCH PERMIT REQUIREMENTS

Parameter	Allowable Discharge
Total Effluent Volume	54 900 000 GPD (250 000 m^3/d)
Total Suspended Solids	62 000 lbs/day (28 000 kg/d)
BOD_5	93 000 lbs/day (42 000 kg/d)
Toxicity	50% survival in a 30% effluent concentration over a 96 hour exposure time on a neutralized sample.
Temperature	35°C

TABLE 3 FEDERAL REQUIREMENTS

Process	Allowable Discharge	
	Suspended Solids	BOD_5
Hydraulic Debarking	5 lb/ODT of wood	
Kraft Pulping	7 lb/ADT	64 lb/ADT
Kraft Bleaching	6 lb/ADT	27 lb/ADT
Kraft Sheet Formation	2 lb/ADT	
Groundwood Pulp Sheet Formation (Newsprint)	3 lb/Product Ton of Chem. Pulp 5 lb/Product Ton of Mech. Pulp	
Groundwood Pulping	13 lg/ADT	
Groundwood Brightening	2 lb/ADT	
Kraft Paper Making (Multi product)	25 lb/ADT	
Toxicity	80% survival at 65% V/V concentration over 96 hours	

TABLE 4 1976 EFFLUENT QUALITY RESULTS

Month	Flow x 10^6 IG/D	BOD_5 LB/ADT	BOD_5 Tons	Suspended Solids LB/ADT	Suspended Solids Tons
January	46.5	64.3	46.07	44.8	32.11
February	45.4	64.0	46.13	41.9	30.22
March	44.8	61.5	44.17	40.2	28.92
1st Quarter	45.6	63.3	45.46	42.3	30.42
April	42.9	62.4	45.74	36.9	27.06
May	48.0	82.5	63.93	41.6	32.25
June	47.7	68.4	53.51	42.1	32.97
2nd Quarter	46.2	71.1	54.39	40.2	30.76
July	46.2	66.5	50.93	42.0	32.18
August	46.7	75.8	58.20	41.7	32.02
September	48.8	74.4	55.02	39.3	29.10
3rd Quarter	47.2	72.2	54.72	41.7	31.10
October	48.4	82.7	65.02	38.6	30.32
November	44.7	62.5	44.07	46.7	32.89
December	45.5	83.6	60.90	41.3	30.11
4th Quarter	46.2	76.3	56.66	42.2	31.11
Yearly Average	46.3	70.7	52.81	41.60	30.85

TABLE 5 1977 EFFLUENT QUALITY RESULTS

Month	Flow x 10^6 IG/D	BOD_5		Suspended Solids	
		LB/ADT	Tons	LB/ADT	Tons
January	46.2	69.2	51.08	41.0	30.28
February	41.5	66.6	51.50	32.5	25.13
March	47.6	116.1	85.79	40.3	29.79
1st Quarter	45.1	84.0	62.79	37.9	28.40
April	47.1	71.7	50.75	38.3	27.15
May	48.6	84.4	65.04	35.7	27.53
June	51.2	62.4	49.26	38.4	30.27
2nd Quarter	49.0	72.8	55.02	37.5	28.32
July	50.04	63.0	47.18	36.7	27.50
August	49.0	66.8	49.07	37.1	27.23
September	51.1	61.1	42.48	39.0	27.13
3rd Quarter	50.2	63.6	46.24	37.6	27.29
October	47.8	56.2	40.18	33.8	24.15
November	50.4	70.9	48.43	37.7	25.73
December	48.3	55.7	39.44	36.2	25.65
4th Quarter	48.8	60.9	42.68	35.9	25.18
Yearly Average	48.3	70.3	51.68	37.2	27.30

TABLE 6 BIOASSAY RESULTS

Date	% Survival over 96 hours, Static Testing Concentration (% V/V) Effluent						pH
	49%	42%	37%	30%	24%	18%	
December 8, 1977	100	100	100	80	40	40	7.1
October 4, 1977	100	100	100	100	0	0	7.4
August 3, 1977	100	100	100	70	14	0	7.2
June 1, 1977	100	100	100	100	100	0	6.8
April 5, 1977	100	100	100	100	60	20	7.4
February 1, 1977	100	100	80	80	0	0	7.3
	Concentration (% V/V) Effluent						
	100%	65%	45%	32%	12.5%	5.6%	
December 1, 1976	100	100	100	63	0	0	7.1
October 6, 1976			100	100	0	0	7.3
August 4, 1976		100	100	100	100	44	0 4.4
						3.2% (V/V)	
June 2, 1976	100	100	100	100	0	0	6.6
March 31, 1976	100	100	100	100	80	0	4.8
February 6, 1976	100	100	100	100	0	0	6.1

4 RECEIVING ENVIRONMENT

4.1 Oceanographic Features

Discovery Passage is a relatively shallow narrow channel separating northern Vancouver Island from the British Columbia mainland. It is the main passage for tidal transport between the Strait of Georgia and the Johnstone Strait/Queen Charlotte Strait systems. The passage is characterized by very strong, turbulent tidal streams which reach 15 knots at times in Seymour Narrows. The net currents in Discovery Passage set in a southeasterly direction at speeds up to 6 knots on flood tides, while returning on the ebb at slightly reduced rates.

A number of reports have been generated dealing with the oceanographic features of Discovery Passage. These include: Waldichuk (1956), Waldichuk et al (1968), Brothers (1971), Simons (1974), Beak (1974), Beak (1976), and Beak (1977). From these reports a description of the oceanographic features of Discovery Passage and the effects of pulpmill wastes thereon, may be obtained.

The predominant feature of Discovery Passage is the intense tidal mixing which occurs there and the resulting homogenous water column in terms of temperature, salinity and dissolved oxygen. Waldichuk (1956) reported that more quiescent conditions may exist in the bays and coves along the passage where stratification may occur in times of high runoff or intense solar heating. Waldichuk (1956) also stated that Duncan Bay has fairly rapid circulation resulting from back eddies of the stream in Discovery Passage. These back eddies attain maximum velocities which are much lower than those of the main stream, therefore, the effects of wind on circulation in Duncan Bay can, at times, be relatively large.

Waldichuk et al (1968) obtained physical and chemical oceanographic data from the Discovery Passage - Duncan Bay area in 1956, 1961, 1962, and 1966. In reviewing the results of these surveys, the lowest dissolved oxygen reading noted was a 1962 value of 5.96 mg/l (65% saturation) recorded at a depth of 49 meters at Station D-3 (north and across channel from the mill). In general, dissolved oxygen values were found to be well above 6.5 mg/l at all depths, with gradual reductions

from surface to bottom. Temperatures and salinities were generally homogenous throughout the water column with surface values affected by air temperatures and local runoff, respectively. Water column salinities reported by Waldichuk et al (1968), ranged from approximately 27°/oo in July 1957 to 29°/oo for other periods. Unpublished work carried out by Goyette et al in 1970 and 1971 reported water quality conditions similar to those documented previously. Table 7 presents the average dissolved oxygen concentrations calculated for the water column at some of the stations near to the outfalls as recorded by Waldichuk et al (1968) and Goyette et al (unpublished). Clearly, the dissolved oxygen levels have been maintained at a satisfactory level, particularly considering the proximity of these stations to the effluent discharge point.

In 1974, H.A. Simons (International) Ltd. conducted studies of the currents in Discovery Passage and Duncan Bay in connection with the design and placement of the effluent diffuser. The studies confirmed that good dilution and mixing was available in Discovery Passage and that a back eddy existed in Duncan Bay. As a result of these studies, the diffuser was located 1463 feet (446 m) from shore at a depth of 145 feet (44 m) below HHW. The outfall pipe and diffuser are 48 inches (122 cm) in diameter except for the last 7 feet (2.13 m) which tapers down to 20 inches (50.8 cm) in diameter. The diffuser itself is 500 feet (152 m) long, having a total of 20 ports arranged as outlined below:

Number of Ports	Port Diameter
1	20 inches (50.8 cm)
1	16 inches (40.6 cm)
1	12 inches (30.5 cm)
2	10 inches (25.4 cm)
2	8 inches (20.3 cm)
5	6 inches (15.2 cm)
8	6 inches (15.2 cm) (closed)

The smaller ports are located at the proximal end of the diffuser.

TABLE 7 DISCOVERY PASSAGE - ELK FALLS AVERAGE WATER COLUMN DISSOLVED OXYGEN CONCENTRATIONS (mg/l)

Station	Distance from outfall (miles)	July 1957	Oct. 1961	Nov. 1962	Nov. 1966	Aug. 1970	Jan. 1971
D-3	1.52		6.31		7.89		
D-2	1.18		6.38	6.56	6.56		
E-1	0.98					6.45	7.56
D-10a	0.57	7.41					
D-5	0.44	8.77	6.54	6.46	7.52		
E-2	0.41					6.10	7.42
D-8a	0.25	7.55					
E-3 (D-7)	0.21	8.74	6.58			5.50	7.52
E-4	0.52					6.65	
D-2a	0.54	7.69					
D-8			7.03		8.14		
E-5	0.72					6.33	
D-10	1.36		6.28		8.44		

All "D" stations sampled by Waldichuk *et al* (1968).
All "E" stations sampled by Goyette *et al* (unpublished).

With respect to the effect of the input of the pulp mill wastes into Discovery Passage, the data of Brothers (1971) and Beak (1974, 1976 and 1977) all agree that the effluent is quickly dispersed and carried away with no apparent environmental impact.

Beak (1974) reported that there was a detectable southeasterly drift of the effluent plume on flooding tides which did not extend more than 350 meters as measured by water chemistry. On ebbing tides the plume was carried to the dock and wharf area. The net direction of plume flow was southeasterly. Turbidity, transparency and colour were the parameters which provided the most evident effects of the effluent in the receiving water. Mean turbidity levels were not, however, greater than 5.0 JTU above control values. Non-filterable solids increased slightly in the immediate discharge area. No zone of influence was apparent in terms of dissolved oxygen saturation, resin acids, zinc, sulphides or pH. Beak (1976) found that the effects of the effluent were limited spatially but detectable at different stations at different times, presumably dependent on the tidal current conditions prevailing at the time. The detectable parameters were again turbidity, non-filterable solids, non-filterable volatile solids and color. Changes in temperature, pH, salinity, dissolved oxygen and turbidity were apparent at different stations at different times with no apparent trend, suggesting that pockets of effluent were being detected. Sulphides and resin acid soaps were both non-detectable.

Beak (1977) was the first monitoring report dealing with post diffuser installation conditions. In this study water samples for analysis were obtained one meter below the surface and the effects of the effluent discharge were found to be non-detectable. Although one would expect conditions with respect to the discharge to improve, there may still be a measurable zone of influence below the effluent trapping level, which should be examined.

4.2 Biology

4.2.1 Benthic Conditions. Reports of benthic work carried out at Elk Falls are contained in Brothers (1971) and Beak (1974, 1976 and 1977).

Brothers (1971) found a layer of hydraulic barker debris 1-3 cm thick overlying a sandy substrate at the location indicated as site 2 in Figure 3. The material was black and had a hydrogen sulphide odour indicating a reducing situation. At site 3 the substrate was composed of medium sized cobbles with abundant associated marine life. No fibre or hydrogen sulphide was found at this site.

Beak (1974) reported difficulty in obtaining benthic samples at all six stations illustrated in Figure 4 due to the gravelly nature of the substrate. Under these conditions the value of the data obtained is limited due to the natural clumping of fauna into suitable micro-niches. However, a progressive decline in faunal abundance was detected as one proceeded in a southeasterly direction from control station number 1. The lowest number of organisms were found at stations 2 and 3 the closest stations to the mill outfalls. As one continued further southeast past the outfalls the number of organisms began to increase again. The zone of influence was reported to be approximately 500 meters around the outfall location. Beak (1974) reported sea cucumbers, brittlestars, sea urchins and polychaetes in the vicinity of the outfalls. No fibre deposits of significance were noted in the benthic sampling program. The results documented in Beak's 1976 report were similar to those obtained in 1974. Beak (1977) reported a possible impairment of the benthic community at the station immediately adjacent to the end of the new diffuser outfall. A depression in species diversity was also apparent in the vicinity of the mill.

4.2.2 Intertidal Conditions. All of the intertidal data available for the Elk Falls area have been generated by the Beak monitoring program. Beak (1974) reported that attempts were made to use settling plates to assess mill impact on the intertidal zone. For various reasons this method proved unsuccessful. Since then assessments of intertidal conditions have been qualitative in nature relying on the use of photography.

The Beak (1974) intertidal stations are depicted in Figure 4. That report indicated that the major impact in the intertidal zone had occurred at Stations 2, 3 and 4. The flora at these stations included

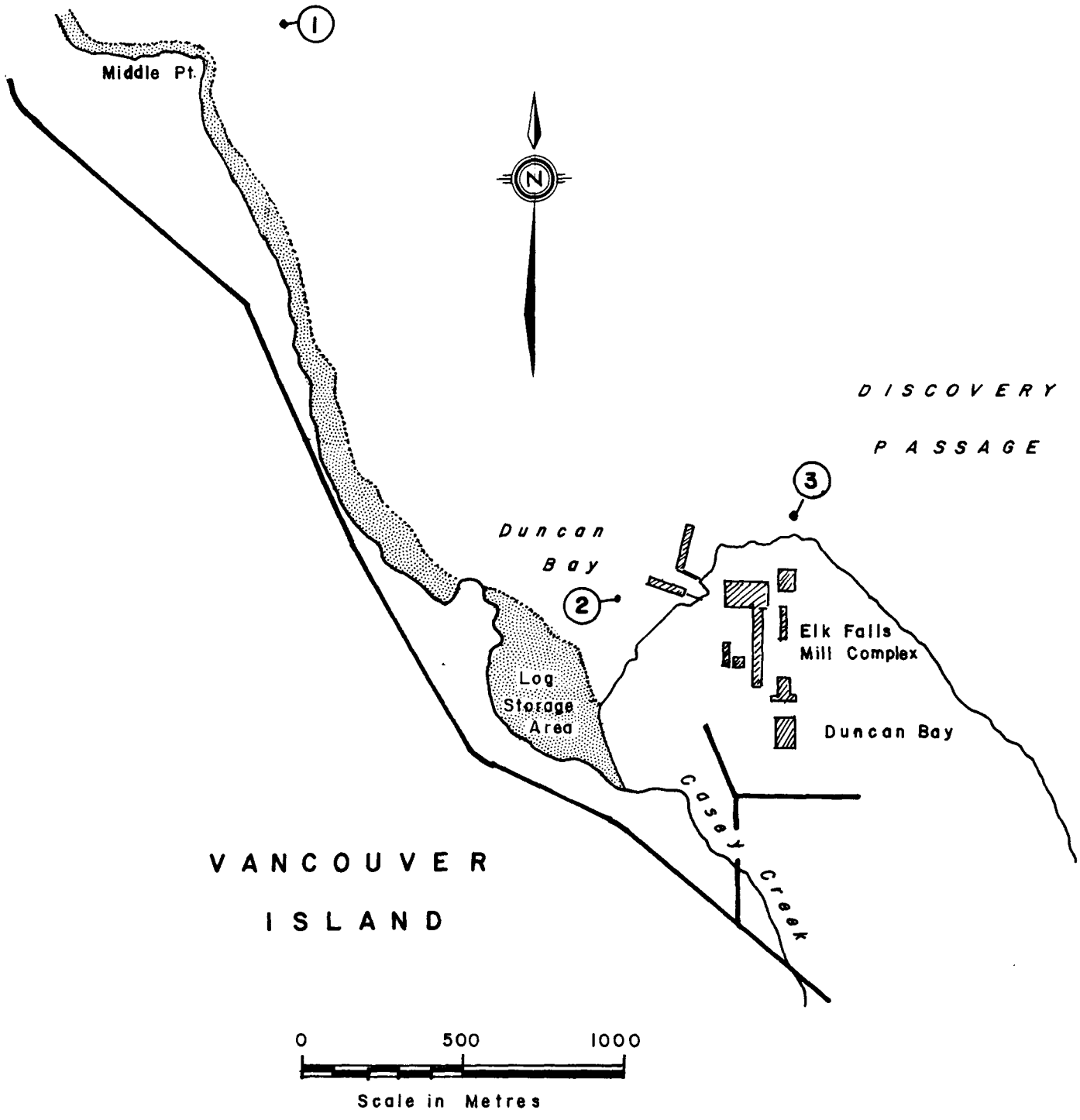

FIGURE 3 BENTHIC SAMPLE STATIONS OF BROTHERS (1971)

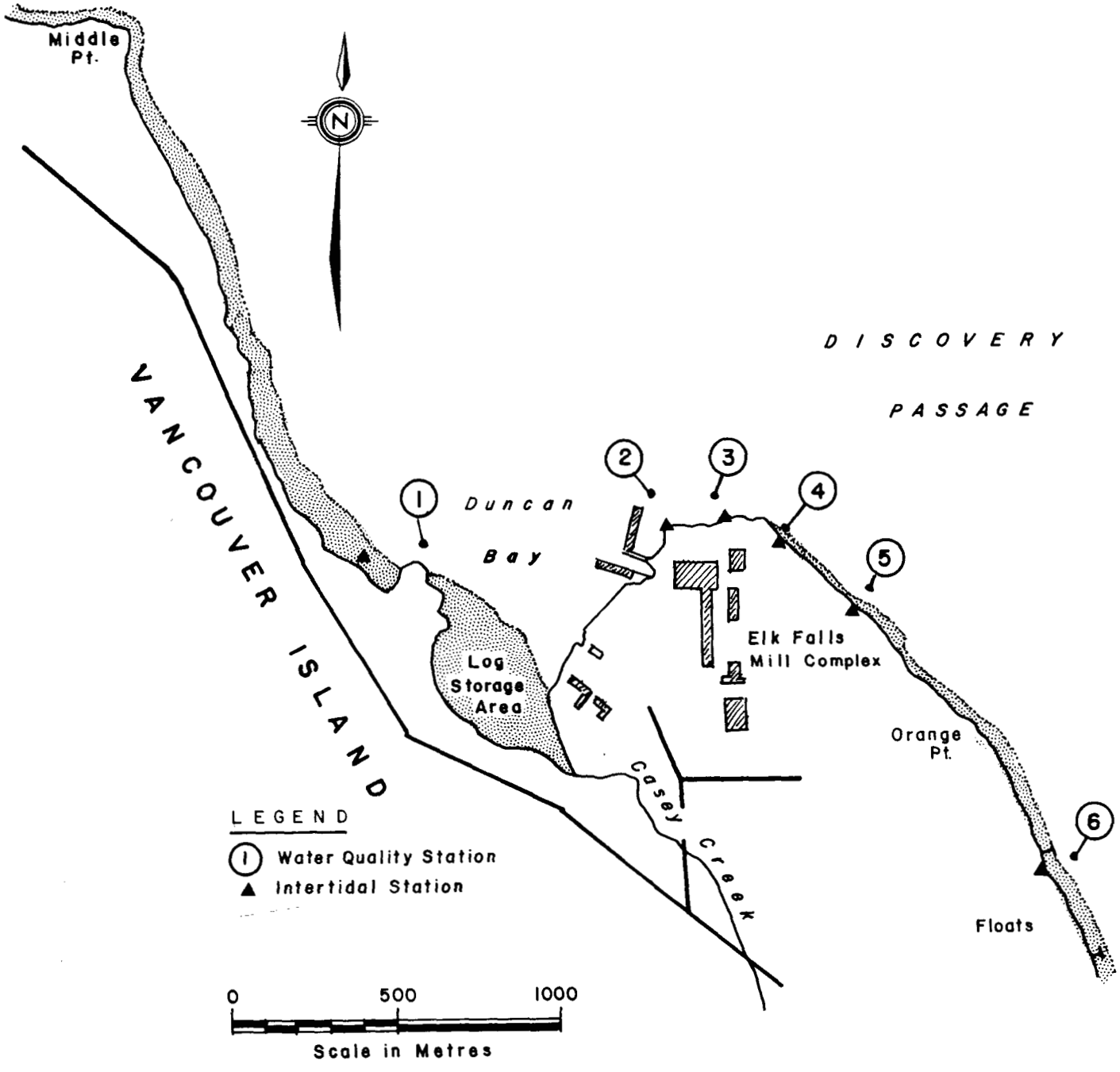

FIGURE 4 SAMPLE STATIONS OF BEAK (1974)

considerable quantities of Enteromorpha sp., brown diatom slimes and the occasional stunted specimen of Fucus sp. Fibre deposits, boiler ash and some wood chips were also observed. The effects of the discharge were most pronounced on the shoreline within the foam containment boom and extended approximately 150 meters in a southeasterly direction. Some recovery was observed at Station 5. Stations 1 and 6 exhibited normal growth; however, Station 6 was not as prolific as may have been anticipated. This was attributed to the periodic intrusions of fresh water from the Campbell River into that area.

Similar conditions were reported in Beak (1976). In the post diffuser operation report (Beak, 1978) it was apparent that a biological recovery was underway in the previous zone of influence. The 1978 photographs in this area showed more prolific growth than photographs contained in the 1976 report. This indicates that discharging through the diffuser has reduced the impact of mill effluent on the intertidal zone.

4.2.3 Effluent Toxicity and Sublethal Effects. As previously mentioned, during the period 1975 to 1977, Elk Falls participated in an effluent toxicity monitoring program with EPS. In this program dilutions of raw, neutralized effluent were used. The data obtained in this program differed considerably from data collected in a bioassay program conducted by Beak Consultants, which used water obtained from the receiving environment rather than effluent. These tests were 96-hour static tests using rainbow trout. Beak (1974) reported that samples collected from Stations 3 and 4 on either side of the foam containment boom were not acutely lethal. Beak (1976) reported that the toxicity at Station 4 ranged from not acutely lethal to an LC_{50} of 35%. Beak (1977) reported that all receiving water samples collected after diffuser installation were not acutely lethal.

Sampling was conducted in 1973, in the vicinity of Elk Falls in connection with a monitoring program to determine the levels of zinc in shellfish (Nelson and Goyette, 1976). Zinc has been determined to accumulate in shellfish, especially oysters, as a result of the discharge of effluent containing zinc from the zinc hydrosulphite bleaching process used

in groundwood mills at that time. It was reported (Nelson and Goyette, 1976) that although some accumulation of zinc had occurred in the vicinity of Elk Falls the problem was not as acute as at other coastal mills. This was attributed to the excellent flushing characteristics of the area. Elk Falls has since changed over to the boral process for groundwood brightening which does not present a problem with respect to bio-accumulation.

5 NATURAL RESOURCES

5.1 Migratory Bird Resources

The Canadian Wildlife Service submission to the pulp mill review process (Trethewey, 1977) stated that no quantitative data existed for the area directly affected by the mill. The nearest major area of waterfowl and seabird habitat is the Campbell River estuary where large numbers have been observed, particularly during the spring migration northward. Other areas in the vicinity which support waterfowl and seabirds, both migrating and resident, are the heads of Duncan and Menzies bays and the north arm of Gowlland Harbour (Bell and Thompson, 1977). In general, it does not appear as though the Elk Falls pulp mill is exerting a profound impact upon the migratory bird resource which utilizes the area.

5.2 Fisheries Resource

Discovery Passage is the principal northern migration route for all salmon and steelhead stocks moving to and from the spawning grounds of the tributary rivers and streams of the Strait of Georgia. The area between approximately Quathiaski Cove and Cape Mudge in particular is world renowned for its Tyee salmon sport fishing. Discovery Passage also supports a substantial commercial salmon fishery. The Campbell River supports significant runs of chinook, pink, chum and coho salmon as well as smaller steelhead and sockeye populations.

The Campbell River area also represents the northern distribution limit of the oyster (Crassostrea gigas)which is harvested both commercially and for recreational purposes from beds on southern Quadra Island.

A complete review of the fisheries resources of the area is contained in Appendix I which is the Fisheries and Marine Service submission to the Pulp Mill Review process.

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APPENDIX I

CROWN ZELLERBACH PULP AND PAPER MILL, ELK FALLS, B.C.
FISHERIES RESOURCES OF FISHERIES AND MARINE SERVICE STATISTICAL AREA 13

The information presented in this document was collated solely for use within the Pacific Region (DFE) "Pulp Mill Review Process": a process designed to determine effluent characteristics, degree of treatment, and effects upon the receiving environment. This task was carried out to identify current and potential conflicts between aquatic resources and effluent disposal in order to priorize pollution abatement efforts.

Opinions expressed in the text reflect the judgement of the authors and contributing personnel.

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DEPARTMENT OF FISHERIES AND THE ENVIRONMENT
FISHERIES AND MARINE SERVICE

Crown Zellerbach Elk Falls Pulp and Paper Mill Fisheries Resources of Fisheries and Marine Service Statistical Area 13

by

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Resource Services Branch
Habitat Protection Unit
1978

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CROWN ZELLERBACH ELK FALLS PULP AND PAPER MILL
FISHERIES RESOURCES OF
FISHERIES AND MARINE SERVICE STATISTICAL AREA 13

I INTRODUCTION

The Elk Falls pulp and paper mill, operated by Crown Zellerbach, is located at Duncan Bay in Discovery Passage approximately 3 miles north of the outlet of the Campbell River. It falls within Statistical Area 13, the Quathiaski subdistrict (Figure 1). The largest population center is Campbell River, with a present population of 11,500. (1)

It is often more difficult to delineate the potential area of impact along an open, well-flushed coast than in a confined inlet which may receive freshwater drainages. A study conducted by the Environmental Protection Service suggested the pulp mill effluent may be concentrated at Francisco Point by eddy currents resulting from tidal action, and at Oyster Bay, 10 miles south of Campbell River. (2) The extent of the effluent's influence to the north is uncertain. While information indicates a net southeasterly current through Discovery Passage and, therefore, a minimal effect to the north, it has been suggested that the ebb tide is strong enough to extend the zone of influence as far as Menzies Bay. The visible effluent plume has been known to extend at least as far as Race Point, six miles north of the mill. (3)

II SALMON

A. Stocks

Table 1 gives the annual salmon stocks (catch + escapement) for Area 13 from 1966 to 1975. All five species of Pacific salmon are present in the area. Total average stocks for the period 1966 to 1975 range from 44,400 for chinook to 579,400 for pinks. Respective values for coho, sockeye, and chum are 95,400, 143,700, and 502,300 pieces. Unfortunately, the figures may not accurately represent total stocks as a significant proportion of the salmon migrating through the area are harvested in the Johnstone Strait fishery. (4, 5)

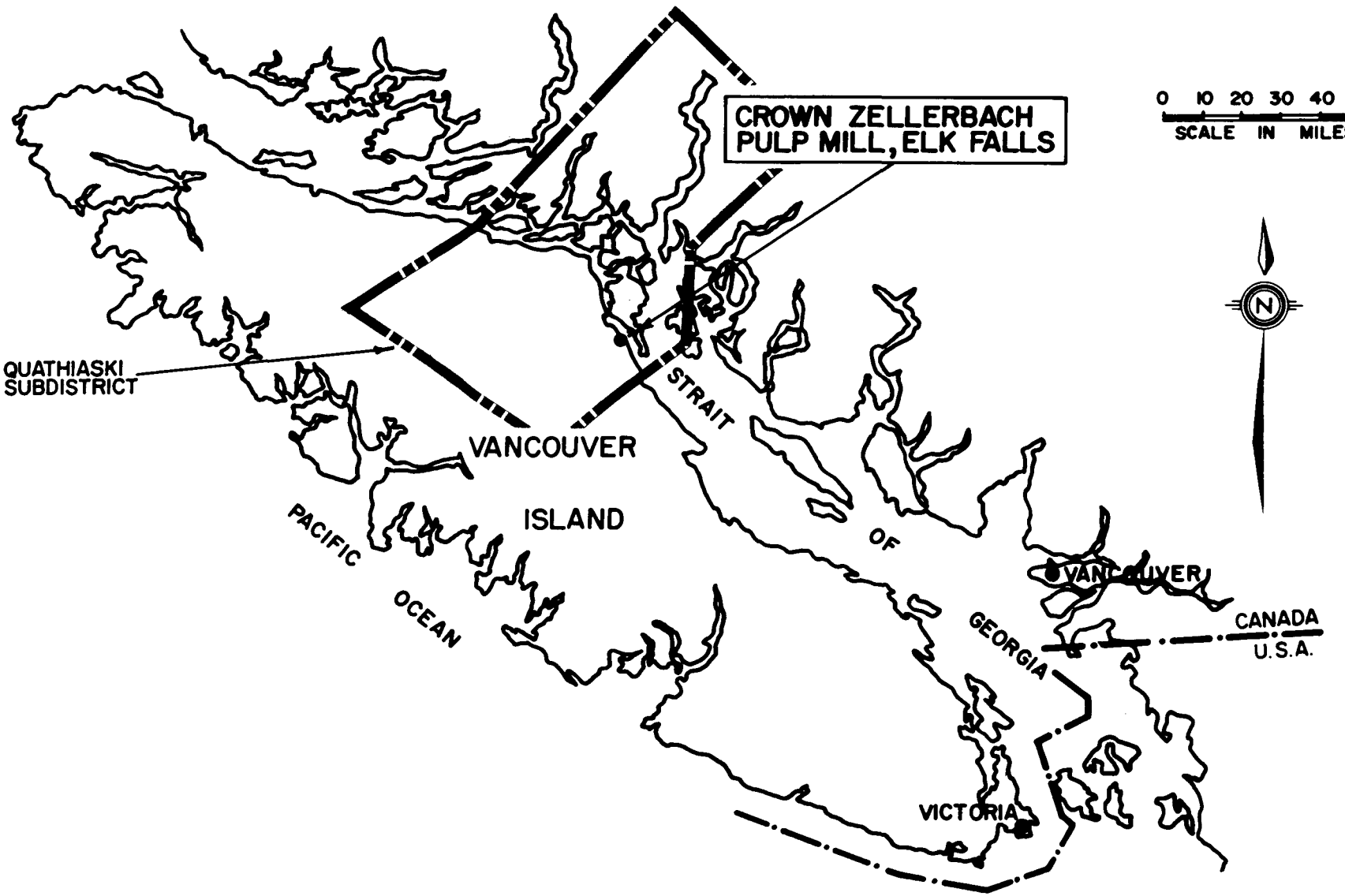

FIGURE 1—LOCATION OF CROWN ZELLERBACH PULP AND PAPER MILL (ELK FALLS) IN STATISTICAL AREA 13

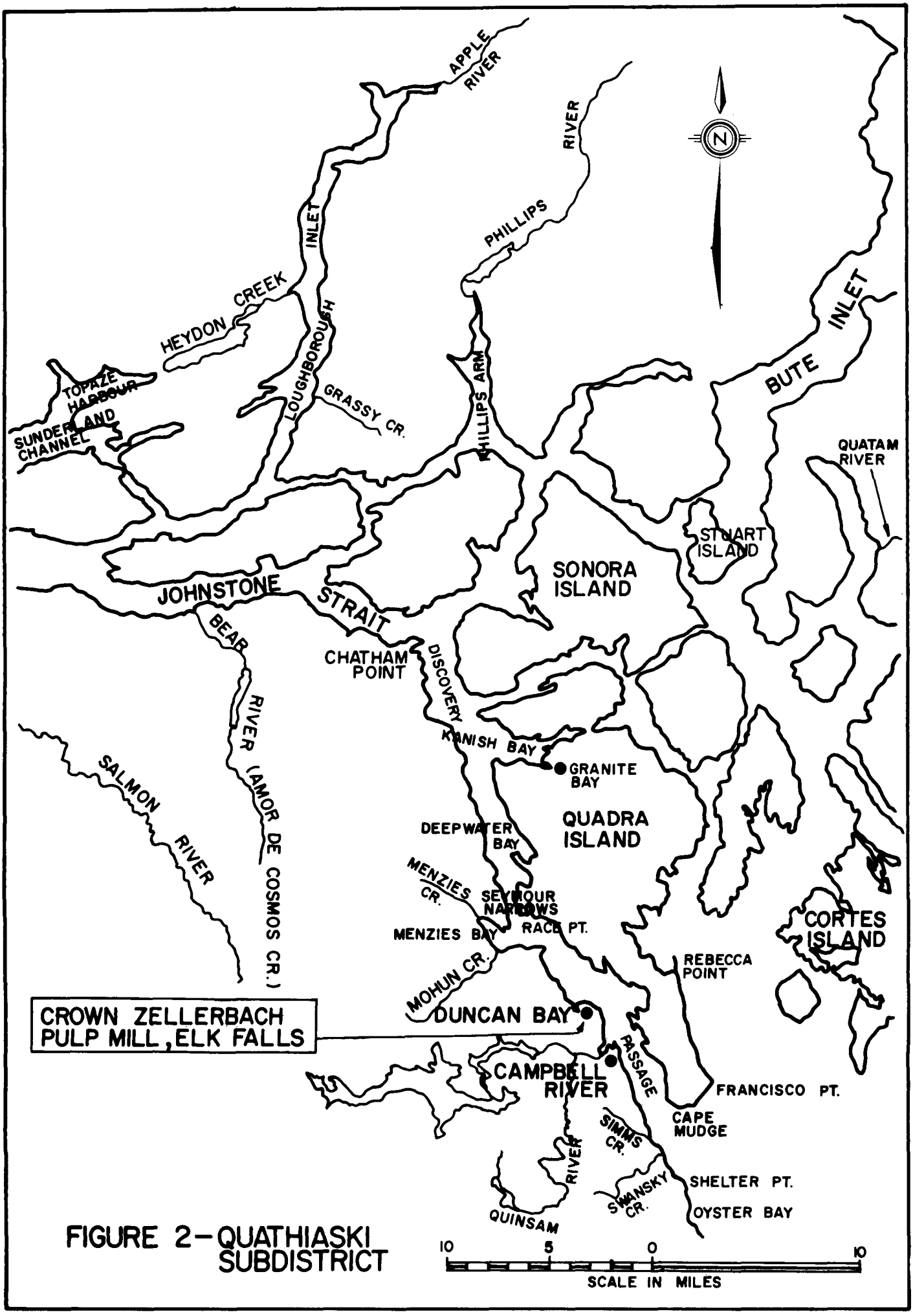

FIGURE 2—QUATHIASKI SUBDISTRICT

TABLE 1

Area 13 - Campbell River - Salmon Stocks,

Based on Catch Plus Escapement(6,7,8)

YEAR	SOCKEYE	COHO	PINK	CHUM	CHINOOK
1975	30,650	75,200	627,350	131,575	47,575
1974	255,425	50,675	514,825	1,244,925	44,150
1973	85,550	91,150	677,325	1,387,825	49,025
1972	97,300	41,675	290,900	879,825	45,900
1971	136,250	113,650	963,825	50,700	61,500
1970	180,875	103,475	407,125	474,475	41,225
1969	90,100	29,275	166,900	315,200	36,800
1968	144,100	94,125	819,400	385,450	31,750
1967	273,900	136,725	749,650	110,025	44,025
1966	143,100	218,050	576,900	43,550	41,650
AVERAGE	143,700	95,400	579,400	502,300	44,400

Over the past 8 or 9 years, declines in coho stocks have been reflected in the commercial catch statistics (Table II) and escapements (Table III). Simultaneous increases in sport catches (Table V), however, suggest that the decrease may not be as severe as expected.

Enhancement of area stocks was begun with the opening of the Quinsam River Hatchery in 1975. This year (1977) will see the first benefits from the program with the return of adult coho. Adult chinook are expected in 1978. The facility also has the capacity for hatching and raising steelhead, but this program has not yet been implemented.(9)

B. Commercial Catch

The salmon fishery in the Quathiaski Subdistrict occurs throughout Discovery Passage and Johnstone Straits. A troll fishery (mainly for chinook and coho) is permitted throughout the Passage, while the net fishery is excluded from the waters south of Seymour Narrows to Cape Mudge. Approximately 20 years ago the center of fishing activity moved from the mouths of Gulf of Georgia inlets to Johnstone Strait. As a result, catches within the Gulf have decreased. Fishing pressure on pinks and chums has been particularly intensified in Johnstone Strait over the last 15 years.(9)

Average catches for the two five year periods, 1966 to 1970 and 1971 to 1975, indicate decreases in sockeye and coho and increases in pink, chum and chinook salmon (Table II). Due to the large proportion of migrant salmon moving through the area, it is difficult to determine exploitation rates. Some steelhead are also caught incidentally during commercial fishing. Steelhead catch figures are given in Table IX.

C. Escapements

The Quathiaski Subdistrict contains a total of 44 streams in which salmon regularly spawn. Table III shows the escapements for Area 13 for 1966 to 1975, with five year averages. Average escapements between 1966 to 1970 and 1970 to 1975 for sockeye, pink and chinook salmon have remained relatively constant while average chum salmon escapements have increased by 88%. Coho escapements have dropped by 29%. The maximum escapement for sockeye in this ten year period was 11,000 pieces (1966), while the maximum for coho was 52,425 (1968). The maximum escapement of 589,950 pink salmon also occurred in 1968, and there is some evidence that escapements may be increasing again.

TABLE II

Area 13 - Campbell River - Commercial Salmon Catch(6)

(IN PIECES)

YEAR	SOCKEYE	COHO	PINK	CHUM	CHINOOK
1975	25,173	48,157	318,726	138,042	34,796
1974	248,571	17,590	173,820	114,146	34,714
1973	78,100	67,273	422,855	1,150,459	32,031
1972	88,611	23,684	84,361	617,142	31,058
1971	127,859	82,066	851,369	19,741	47,352
AVERAGE 1971-75	113,663	47,754	3,702,261	407,900	35,990
1970	171,876	62,214	184,981	341,346	28,291
1969	84,918	19,300	152,341	269,368	24,859
1968	46,702	41,701	229,454	268,057	19,157
1967	268,927	103,434	697,206	61,427	30,726
1966	132,119	167,216	212,912	6,032	27,625
AVERAGE 1966-70	140,908	78,773	295,379	189,246	26,132

TABLE III

Area 13 - Campbell River - Salmon Escapements(7,8)

(IN PIECES)

YEAR	SOCKEYE	COHO	PINK	CHUM	CHINOOK
1975	5,475	27,050	308,625	93,525	12,775
1974	6,850	33,075	341,000	94,475	12,125
1973	7,450	23,875	254,475	237,375	17,005
1972	8,700	18,000	206,525	262,675	14,850
1971	8,400	31,600	112,450	30,950	14,150
AVERAGE 1971-75	7,375	26,725	244,625	143,800	14,175
1970	9,000	41,250	222,150	133,125	12,925
1969	5,200	9,975	14,575	45,825	11,950
1968	7,275	52,425	589,950	117,400	12,600
1967	5,000	33,300	52,450	48,600	13,300
1966	11,000	50,825	364,000	37,525	14,025
AVERAGE 1966-70	7,500	37,500	248,600	76,500	13,000

The following table ranks the major spawning streams for each species based on average annual escapements for 1966 to 1975.

	SPECIES				
RANK	SOCKEYE	CHINOOK	COHO	CHUM	PINK
1	Heydon	Campbell	Southgate	Orford	Phillips
2	Phillips	Southgate	Salmon	Heydon	Amor de Cosmos
3		Homathko	Quinsam	Southgate	Grassy
4			Homathko	Homathko	Orford
5			Quatam	Apple	Apple
6			Village Bay	Phillips	Village Bay

Of the above streams, only the Campbell and Quinsam rivers empty into Discovery Passage. The remainder are relatively distant from the Elk Falls pulp mill.

Table IV enumerates escapements for 1966 to 1975 for all spawning streams emptying into Discovery Passage between Chatham Point and the southern boundary of the Subdistrict. The Campbell and Quinsam Rivers support all five species of Pacific salmon. The remaining water bodies account for small escapements. Four of the streams - Granite, Kanish, Menzies and Mohun Creeks, support escapements of coho, pink and chum, while Simms and Swansky Creeks have runs of coho.

The Elk Falls pulp mill is strategically located with respect to salmon migrations, Discovery Passage being the favoured northern route for stocks moving either into or out of the Gulf of Georgia. While there does not appear to be any tendency for salmon to use the same route for movements in both directions, rearing fish on the outward migrations may prefer to remain east of Quadra Island, where less turbulent waters permit higher accumulations of their food.(4) Also there is a tendency for migrants within the Gulf to remain on the side from which they originated. This could be significant in light of the suggested zone of influence of the pulp mill.

Beyond general observations, there is little species-specific information. Rearing chinook may occasionally concentrate within the Gulf of Georgia or at the mouths of inlets. Chinook tend to be quite mobile, especially in the nearshore. Coho are also quite mobile, but prefer offshore waters.(5) A study conducted by the Fisheries Service in 1974 found that the Campbell River estuary as well as the intertidal zone served as a rearing area for juvenile coho, chinook and chum salmon.(10) It was found that coho and chinook were present from February

through November and chum from March through December.(10) It would seem probable that other stream mouths might provide similar rearing habits.

TABLE IV

Discovery Passage Escapements(7,8,11)

a) Campbell River Mainstem

YEAR	SOCKEYE	COHO	PINK	CHUM	CHINOOK
1975	25	400	1,500	3,000	2,500
1974	75	1,500	4,000	3,500	2,500
1973	150	1,000	1,000	4,000	4,300
1972	75	1,500	3,500	3,500	7,500
1971	75	1,500	750	1,500	7,500
AVERAGE	80	1,180	2,150	3,100	4,860
AVERAGE 1966-70	80	1,660	2,400	1,850	4,000

b) Quinsam River

1975	25	3,500	30,000	400	200
1974	N.O.	3,500	7,500	400	75
1973	N.O.	4,600	4,000	1,000	5
1972	N.O.	1,500	3,500	1,500	75
1971	N.O.	1,500	400	400	25
AVERAGE	5	2,900	9,100	750	75
AVERAGE 1966-70	0	2,550	1,350	500	N.O.

c) Granite Creek

1975	75	N.O.	200
1974	25	N.O.	200
1973	N.O.	N.O.	200
1972	25	400	400
1971	25	N.O.	400
AVERAGE	30	80	280
AVERAGE 1966-70	50	4,800	800

N.O. = None Observed

TABLE IV Cont'd

Discovery Passage Escapements

d) Kanish Creek

YEAR	COHO	PINK	CHUM
1975	25	N.O.	200
1974	25	75	400
1973	25	N.O.	200
1972	25	3,500	750
1971	N.O.	N.O.	750
AVERAGE	20	715	460
AVERAGE 1966-70	55	3,800	870

e) Menzies Creek

1975	N.O.	N.O.	200
1974	200	400	400
1973	25	N.O.	400
1972	75	400	400
1971	200	N.O.	200
AVERAGE	100	160	320
AVERAGE 1966-70	405	2,500	430

f) Mohun (Trout) Creek

1975	400	N.O.	200
1974	750	25	200
1973	200	N.O.	750
1972	400	400	25
1971	1,500	N.O.	200
AVERAGE	650	85	275
AVERAGE 1966-70	1,045	2,900	240

TABLE IV Cont'd

Discovery Passage Escapements

g) Simms - Swansky Creeks Coho Escapements

YEAR	Simms Creek	Swansky Creek
1975	400	400
1974	750	1,500
1973	1,500	1,500
1972	200	400
1971	750	1,500
AVERAGE	720	1,060
AVERAGE 1966-70	350	1,450

N.O. = None Observed

The following table gives migration and spawning times of Pacific Salmon and steelhead for the area (9,11).

SPECIES	UPSTREAM MIGRATION	SPAWNING
Sockeye	July - September	Last week of September to mid-October
Coho	Last week of July to December	October - January; peak in October
Pink	End of July to late August	August to November; peak in October
Chum	September - October	Mid October to January; peak in mid-October to beginning of November
Steelhead	Mid-November to mid-March	Mid-November to mid-March

D. Sport Fishery

i) Tidal

One of the most intensive sport fisheries in the province occurs off the mouth of Campbell River.(11) It is the most popular recreational activity in the area, and is responsible for a significant proportion of Campbell River's revenue. Perhaps the best known sport fishery is for Tyee (chinook over 30 pounds) that occurs at the mouth of the Campbell River during the annual spawning migration.(11)

The major tidal sport fishing areas within the Quathiaski Subdistrict are Phillips Arm, Cortes and Stuart islands, the mouth of the Salmon River at Sayward, and the length of Discovery Passage to Chatham Point in the north. Within Discovery Passage, the sport fishery is most heavily concentrated between Brown Bay and Cape Mudge.(9) Lingcod are taken by sport fishermen, the main areas of utilization being Willow Point, the buoy off Cape Mudge and Copper Bluffs (across from Duncan Bay, north to Seymour Narrows).(9) The entire foreshore from Swansky Creek to Menzies Bay is fished for coastal cutthroat trout.

The increases in all species harvested between 1966 and 1975 is illustrated in the five-year averages of sport catches. (Table V). In the periods 1966 to 1970 and 1971 to 1975, the annual sport catch rose from 40,000 to 65,800. During these two periods, average annual effort (in boat days) increased from 34,700 to 43,450.

TABLE V

Area 13 - Salmon Sport Fishery - Tidal Waters(12)

YEAR	CHINOOK	COHO	PINK & OTHERS*	TOTAL	EFFORT (BOAT DAYS)
1975	12,900	53,300	3,775	69,975	45,670
1974	18,300	55,125	200	73,625	47,450
1973	17,675	48,000	2,200	67,875	42,300
1972	16,475	34,350	2,300	53,150	41,100
1971	9,800	52,825	1,925	64,525	40,800
AVERAGE 1971-75	15,000	48,725	2,100	65,800	43,450
1970	9,000	31,475	1,850	42,325	37,900
1969	6,575	12,700	725	20,000	36,100
1968	5,700	25,950	625	37,400	32,125
1967	7,550	29,750	4,100	43,100	34,125
1966	4,525	48,600	1,025	57,350	33,275
AVERAGE 1966-70	6,675	29,700	1,675	40,000	34,700

* Others include sockeye and chum.

ii) Non-Tidal

The Campbell-Quinsam River system is probably the most important non-tidal fishery area of Discovery Passage, not only because of the close proximity of the town of Campbell River, but also because of the river's consistent water supply. The most important non-salmon species are steelhead, which are fished from mid-November to April and coastal cutthroat, available throughout the year. Dolly varden are not important in this system. (3)

Of the remaining streams flowing into Discovery Passage, Menzies and Mohun Creeks support small numbers of steelhead and populations of sea run cutthroats. Coho are taken with fly. Simms and Swansky Creeks have good stocks of coho and sea run cutthroat. The latter make up approximately one-third of the total number of juvenile salmonids in Swansky Creek. Kanish and Granite Creeks (which drain into Kanish Bay on the northwest coast of Quadra Island) are both utilized to some degree for sport fishing. There appear to be neither salmon escapements nor significant populations of anadromous trout in Duncan Bay Creeks.

Table VI gives the steelhead sport catch statistics for all rivers within Discovery Passage where survey data has been completed. Figures were not available for Mohun and Granite Creeks for the complete ten year period.(13)

E. Indian Food Fishery

A total of four Indian bands utilize the fisheries of the area for food. The Campbell River and Cape Mudge bands live within the Statistical area, the Comox and Big Qualicum bands further south. The bulk of the catch is taken by purse seine from Johnstone Strait and Discovery Passage (especially Deepwater Bay and the waters just north of Seymour Narrows). Gillnets are used, occasionally small quantities of fish are also taken by gaffs and spears in Hyacinthe Creek.(14)

As table VII shows, all five species of Pacific salmon are taken, as well as the occasional steelhead. Chum are the most frequently caught species.

III HERRING

The main herring spawning sites for the Quathiaski Subdistrict since 1970 have been the heads of Bute and Loughborough Inlets, Kanish, Deepwater and Plumper Bays and, on the east side of Quadra Island, Heriot and Hyacinthe Bays (Figure 3).

TABLE VI

Area 13 - Steelhead Sport Catch (Estimated)*(13)

a) Campbell River

YEAR	EFFORT (DAYS FISHED)	NUMBER OF ANGLERS	CATCH (PIECES)
1975-76	4,640	777	1,264
1974-75	3,673	638	1,015
1973-74	3,704	735	737
1972-73	2,478	603	524
1971-72	2,828	510	453
AVERAGE	3,465	653	799
AVERAGE 1966-70	3,988	616	536

b) Quinsam River

1975-76	1,545	433	656
1974-75	1,506	335	754
1973-74	1,485	353	534
1972-73	792	279	291
1971-72	746	238	163
AVERAGE	1,215	328	480
AVERAGE 1966-70	1,749	464	422

c) Mohun (Trout) Creek

1975-76	217	43	25
1974-75	112	34	27
1973-74	49	31	4
1972-73	49	30	7
1966-67	116	16	16

d) Granite Creek

1975-76	50	5	30
1974-75	10	3	0
1973-74	4	4	4

* Steelhead figures are obtained by a postcard survey system and estimates are made from reported figures.

TABLE VII

Area 13 - Campbell River - Indian Food Fishery(1)

(Catch in Pieces)

YEAR	SOCKEYE	COHO	PINK	CHUM	CHINOOK
1975	1,995	1,013	2,313	5,656	172
1974	708	309	215	6,950	26
1973	208	40	951	3,513	55
1972	670	268	52	4,690	40
1971	849	314	455	3,187	17
1970	123	456	21	4,587	49
1969	1,451	106	578	3,346	104
1968	185	291	213	3,360	23
1967	579	251	1,452	1,708	13
1966	86	698	196	1,487	5

TABLE VIII

Area 13 - Campbell River

Commercial Herring Catch and Miles of Spawn(15,16,17,18)

YEAR	CATCH (000's LBS.)	AMOUNT OF HERRING SPAWN (STATUTE MILES)
1975	2,773	21.7
1974	945	11.4
1973	1,939	8.4
1972	3,599	22.2
1971	5,619	28.8
1970	Nil	17.9
1969	Nil	7.8
1968	1,150	0.3
1967	91,783	2.8
1966	238,373	2.3

While Deepwater and Plumper Bays are close enough to be under the influence of the Elk Falls mill, they are probably of lesser spawning importance.(1)

Table VIII gives the herring catch statistics and statute miles of herring spawn compiled since 1966. Catches prior to 1969 represent the herring reduction fishery while since 1971, the greater proportion has been for food and bait. In 1973, the largest proportion of catch (760 tons for the area) came from Kanish Bay (400 tons) for food, bait and roe. Hyacinthe Bay and Loughborough Inlet were the sources for the remaining catch.(14) In 1974, Deepwater Bay was the site of some seining activity. The roe herring fishery has never been significant by west coast standards. The spawn occurs late in the season by which time most fishing vessels have moved to fishing grounds further to the north. Further more, stocks in some areas (eg. Bute Inlet) are small, resident fish whose eggs are of less value.(14)

IV HALIBUT AND GROUNDFISH

Halibut are harvested in a small drag fishery with commercial catches from 1966 to 1975 ranging from zero to 5400 lbs. The annual average harvest was 700 lbs. (Table IX).

Groundfish catches (mostly by trawl) have declined since 1966. Average catches for 1966 to 1970 were 640,400 lbs. compared to the 1971 to 1975 level of 252,200 lbs. (Table IX). Trawling activity is centered in Deepwater Bay and Phillips Arm. The major species harvested are ling, red, rock and gray cod. Ling cod comprise the most important fraction of the commercial groundfish harvest and are also utilized by sport fishermen. Catch figures for ling cod are given in brackets beside total groundfish in Table IX. As mentioned previously (see Sport Fishery section), the main areas for ling cod are Willow Point, Cape Mudge and Copper Bluffs. There are also some concentrations in Kanish and Plumber Bays.(4)

V CRUSTACEANS

There is only a minor shrimp fishery within the influence of the Elk Falls pulp mill. Most prawns are taken commercially in Loughborough and Bute Inlets. Small quantities are taken by people fishing recreationally.(3) The Campbell River Statistical Area contains relatively low crab stocks. Commercial catches are restricted to Phillips Arm, while recreational catches are taken in Phillips Arm, Heydon Bay, the mouth of the Campbell River and Menzies Bay.(9,14) Shrimp and crab commercial catches are given in Table IX.

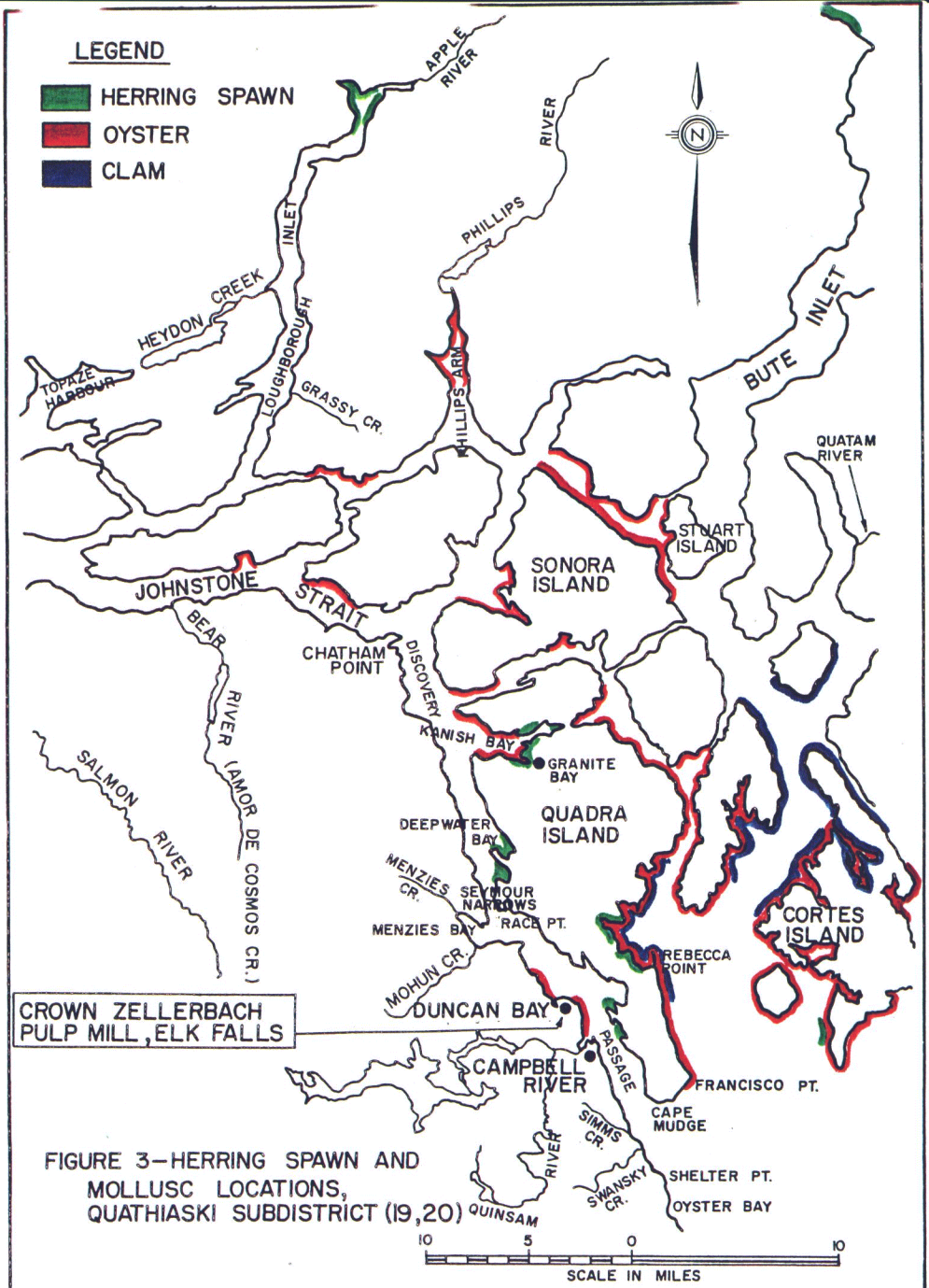

FIGURE 3—HERRING SPAWN AND MOLLUSC LOCATIONS, QUATHIASKI SUBDISTRICT (19,20)

TABLE IX

AREA 13 - Campbell River

Commercial Catch Statistics, Other Species(6)

In Hundredweight (cwt)

YEAR	STEELHEAD (PIECES)	TOTAL GROUNDFISH	(LING COD)	SHRIMP	CLAMS	CRABS	HALIBUT
1975	35	2610	(1520)	40	1180	160	-
1974	31	2500	(2140)	40	5740	170	-
1973	86	2170	(1380)	220	1760	360	-
1972	84	2760	(2440)	18	5820	-	3
1971	53	2568	(1902)	30	3402	-	-
AVERAGE	58	2522	(2522)	70	3580	-	-
1970	35	4353	(3592)	66	1059	-	4
1969	75	12230	(4411)	231	369	29	54
1968	112	4572	(4354)	113	1067		2
1967	84	5907	(5317)	198	930	17	1
1966	101	4960	(4783)	255	Nil	-	15
AVERAGE	81	6404	4491	172	693	-	15
10 YEAR AVERAGE	69	4463	3183	119	2132	73	7

Catches less than 1 cwt are not recorded.

Bracketed figures adjacent Total Groundfish are annual ling cod catches.

VI MOLLUSCS

Table IX presents the shellfish catches from 1966 to 1975. Substantial stocks of clams exist throughout the Subdistrict, the largest at Cape Mudge. The primary commercial harvest occurs at the west end of the Subdistrict near Sunderland Channel and Topaze Harbour. Clams are taken recreationally throughout the area.(9)

Oysters in the Campbell River area are at the northern limit of their range. There are no oysters west of Seymour Narrows. The most important beds, with respect to the Elk Falls mill, are on the southeastern shores of Quadra Island, where oysters are taken for both commercial and recreational purposes. Cortes Island also contributes a significant proportion to the oyster fishery(9).

A shellfish closure, due to contamination, is in effect from Orange Point, north of Campbell River, to Shelter Point.(9) Figure 3 shows the location of clam and oyster beaches.(14,20) It must be emphasized that Figure 3 gives only approximate indications of stock locations and may not be complete.

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