KELP INVENTORY, 1978

NORTHWEST COAST OF VANCOUVER ISLAND

by

L. M. Coon, W. G. Roland, I. R. Sutherland and R. A. Hall

Fisheries Development Report No. 28

Marine Resources Branch
Ministry of Environment
Province of British Columbia

March, 1982

ABSTRACT

The Kelp Inventory Method (KIM-1) developed by Foreman (1975) was used to estimate standing crop biomass of two canopy forming kelps along the northwest coast of Vancouver Island. Results indicated that 35,044 tonnes of pure Nereocystis luetkeana, 523 tonnes of pure Macrocystis integrifolia and 247 tonnes of these kelps in mixed stands were available at mean water level in this region. Total bed surface area was estimated to be 840 hectares. Five charts are presented which show the position, extent, species, and density classification of every discernable kelp bed for each of five geographic subdivision within the survey area. For management purposes, all inventoried coastlines were divided into permanent, numbered, kilometer wide blocks. The results of this survey are compared to those obtained in a private kelp survey performed in 1967.

ACKNOWLEDGEMENTS

The authors wish to thank Nellie Lee for her careful typing of the several drafts of this manuscript.

INTRODUCTION

Nereocystis luetkeana (Mertens) Postels and Ruprecht and Macrocystis integrifolia Bory form beds along extensive portions of the British Columbia coast. Beginning in 1975 the Marine Plant Management and Development Section of the Marine Resources Branch undertook a program to locate and quantify the standing crop of these economically important kelps using the inventory method (KIM-1) developed by Foreman (1975). Five areas were surveyed in August and September, 1976 (Field et al, 1977; Field and Clark, 1978; Coon et al, 1979; Coon et al, 1980; Coon et al, 1981). This report contains the results of our 1978 survey of the northwest coast of Vancouver Island. A small portion of our survey area overlapped with an earlier survey carried out by M. W. Huff and Co; the results of the two surveys are compared for the area of overlap.

Accurate and comprehensive data on the standing crop of kelp in British Columbia provide a basis for allocating these resources through licensing and for establishing area specific harvest quotas. Because kelp beds are important to other marine species, there are a growing number of other users of kelp inventory data, including those preparing environmental impact statements for major coastal developments. Inventory charts will also be of value to those conducting surveys of herring spawn, abalone and sea urchins (Coon, 1977).

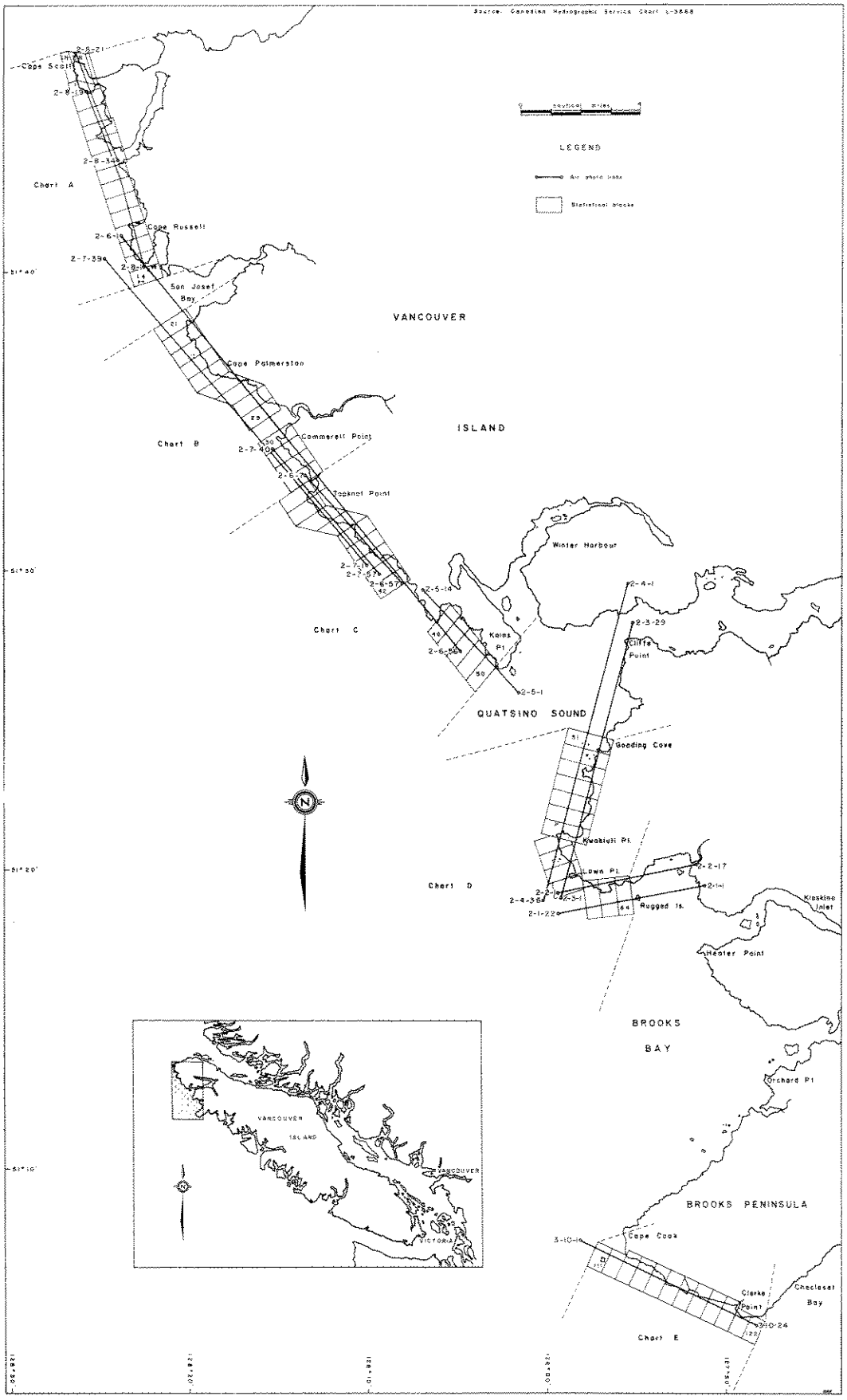

Figure 1: The northwest coast of Vancouver Island, showing the area inventoried for floating kelp resources and the mode of division of this area into inventory charts (see Appendix). Also indicated are the layout of statistical blocks, aerial photographic flight lines and locations of biomass sampling stations.

METHODS

The standing crop of Nereocystis and Macrocystis was estimated by the Kelp Inventory Method (KIM-1) developed by Foreman (1975). Modifications of this method as stated by Coon et al (1977) and Field et al (1977) were used in this study. On September 3 and 4, 1978 the Surveys and Mapping Branch, Ministry of Environment obtained black and white infrared aerial photography of the survey area. Photographic coverage was made along the prescribed flight lines illustrated in Figure 1.

Briefly, the KIM-1 technique involves obtaining 24 cm format black and white infrared (IR) aerial photography of the kelp bed and shoreline in the desired region. These black and white IR negatives are used to prepare charts of the coastline and the offshore kelp beds. On these charts the survey area is divided into 1 km wide statistical blocks. Bed areas for each of six bed types listed below are determined for each block. The density of kelp is determined directly from the photographs with the aid of a microscope. Field crews obtain samples of kelp from the area for mean weight per plant (Nereocystis) or frond (Macrocystis) determination, near the time that the beds are photographed. The total available kelp per block is determined by multiplying the mean weight per plant/frond values by the observed plant/frond densities and multiplying this product by the observed bed areas. The KIM-1 technique identifies six bed types on the basis of:

a) species - Macrocystis or Nereocystis

b) stand purity - pure bed or mixed (42% Nereocystis and 58% Macrocystis; Foreman, 1975)

c) plant or frond density - low (less than 10 plants/fronds per/10 m^2) or high (greater than 10 plants/fronds per/10 m^2).

All bed area and density estimates given in this report are derived from the September, 1978 photography but, since we were unable to field a team to collect mean weight per plant/frond and vertical biomass distribution data at that time, the biomass data used herein was derived from our late August, 1975 sampling efforts in Nootka Sound

(Coon et al, 1977). This data substitution may, of course, introduce considerable error in our overall standing crop estimate.

Foreman (in prep.) has noted in his Malcolm Island study area that the individual plant biomass in Nereocystis populations tends to increase as the bed density decreases. From Foreman's data we determined that in high density portions of the bed a 31% decrease in density between 1974 and 1978 was accompanied by a 48% increase in mean plant weight, and that a 12% decrease in density from 1978 to 1980 was accompanied by a 39% increase in mean plant weight. Thus, relatively small changes in bed density may have large impacts on mean plant weight.

The average densities in high density Nereocystis beds for the whole 1975 survey area in Nootka Sound and the whole 1978 survey area were calculated. Average density in the northwest Vancouver Island survey area was 7.4% lower than that found in the earlier Nootka Sound Survey. On the basis of Foreman's results, it is therefore reasonable to speculate that the use of mean weight per plant data from the Nootka Sound survey could result in a slight underestimation of the Nereocystis standing crop in the northwest Vancouver Island survey area.

Certain areas were photographed when the tide was 1 m higher than the optimal level (MWL $\pm$ 0.6 m) as outlined by Foreman (1975). This resulted in a lower density of plants or fronds on the photographs than would have been seen at MWL. A correction procedure for this is given in Coon et al (1979). This procedure permits the calculation of the plant/frond density at MWL by multiplying the adjusted mean biomass per plant/frond factors given in Table 1 by the plant/frond density recorded from the photographs. Cloud cover obscured some of the sea surface; surf nearshore and around offshore rocks may lead to an underestimation of bed area by obscuring kelp in the IR imagery.

All water depth and tide level calculations were based on actual values obtained from computer-drawn daily tide curves for Brooks Penninsula - Mission Group - Bunsby Island obtained from the Federal Department of Fisheries and Oceans.

RESULTS

Charts A through E (Appendix) illustrate the disposition of kelp resources by bed type along the northwest coast of Vancouver Island. It will be noted from these charts and Figure 1 that certain portions of the coast line are not represented. This is due either to incomplete photographic coverage or the absence of detectable kelp. However, sufficient space and block numbers have been reserved for these unsurveyed areas should the need arise for their inclusion in a later inventory.

Table 1. Mean biomass per plant or frond (kg) factors used to calculate biomass estimates at MWL for the northwest coast of Vancouver Island (from end of August, 1975 Nootka Sound - see text).

Species	No. of Stations	Photography at MWL Blocks 1N,2N,3N,1-14,21-60	Photography at + 1 m Blocks 61-64, 111-122
Nereocystis	4	4.21	6.37
Macrocystis	2	0.86	1.05
Mixed*	-	2.27	3.50

* based on 42% Nereocystis and 58% Macrocystis (Foreman, 1975).

A summary of the field determined biomass data collected at the end of August, 1975 is given in Table 2. This table gives vertical distribution of kelp biomass in 1 m increments above and below MWL. Again, this data is derived from the 1975 Nootka Sound inventory.

Tables 3 and 4 present estimates of bed areas, kelp density and kelp biomass available at MWL, by bed type, for each block as follows:

a) Table 3 - Blocks 1N-50; Cape Scott to Kains Point.

b) Table 4 - Blocks 51-122; Gooding Cove to Clerke Point.

Tables 5, 6 and 7 summarize the bed area and biomass estimates in these tables by bed type, by percent composition of biomass, and by percent composition of bed area for each bed type in each geographical

Table 2: The cumulative number of plants or fronds and their weight (biomass), and the mean weight per plant or frond at one metre increments for samples of Nereocystis and Macrocystis collected off Nootka Sound at the end of August, 1975.

Nootka - 1975

Cutting Depth (m)	End August						
	Nereocystis			Macrocystis			Mixed
	Cum B	Cum N	$\bar{x}$B/plant	Cum B	Cum N	$\bar{x}$B/frond	*$\bar{x}$B/plant or frond
+6	-	-	-	4.04	5	0.81	0.47
+5	16.58	3	5.53	5.90	8	0.74	2.75
+4	42.85	11	3.90	8.34	13	0.64	2.01
+3	98.24	22	4.47	14.62	28	0.52	2.18
+2	159.99	38	4.21	24.72	36	0.69	2.17
+1	231.99	52	4.46	37.42	49	0.76	2.32
MWL	332.67	79	4.21	51.55	60	0.86	2.27
-1	388.02	95	4.08	66.61	67	0.99	2.29
-2	411.20	99	4.15	77.88	73	1.07	2.36
-3	426.91	102	4.19	85.38	74	1.15	2.43
-4	435.54	104	4.19	92.49	81	1.14	2.42
-5	443.14	105	4.22	99.36	83	1.20	2.47
-6	447.13	105	4.26	105.96	89	1.19	2.48

* Values based on 42% Nereocystis and 58% Macrocystis

Cum N = cumulative number of plants or fronds

Cum B = cumulative biomass in kilograms

$\bar{x}$B/plant (frond) = mean biomass per plant or frond in kilograms

subdivision, respectively. A total of 35,994 tonnes of kelp were estimated to be available at MWL along the surveyed coast line (Table 5). The greatest concentration (14,279 tonnes) occurred in Nereocystis beds along 12 km of coast line between Clerke Point and Cape Cook (Table 5). A further 7,831 tonnes of Nereocystis were estimated to lie in beds along 14 km of coast line between San Josef Bay and Top Knot Point. The majority (35,444 tonnes or 98.47%) of the kelp biomass occurred as pure stands of Nereocystis, with 57.64% in low density beds and 40.83% in high density beds (Table 6). Nereocystis beds formed 92.97% of the total bed areas (Table 7); Macrocystis occurred only in small beds scattered along the coast line.

Factors for estimating biomass at selected cutting levels other than MWL are presented in Table 8. By multiplying these factors times the biomass at MWL, an estimate of the amount of kelp available at other tide heights can be obtained. Estimates of Nereocystis and Macrocystis standing crops at the different depth levels are given in Table 9 for the entire survey area. We estimated the total standing crop for all of the surveyed area in September, 1978 to be 48,614 tonnes. This was thought to be a somewhat conservative estimate primarily because of incomplete photographic coverage, and, very secondarily, to inevitable losses of kelp laminae during field sampling procedures which result in under estimation of mean biomass per plant/frond.

Table 3. Estimates of kelp area and biomass for the northwest coast of Vancouver Island: Cape Scott to Kains Points, September, 1978. See Charts A, B and C (Appendix).

	Nereocystis - low density				Nereocystis - high density				Macrocystis - low density				Macrocystis - high density				Mixed - low denisty				Mixed - high denisty					
Block	$\bar{x}$D/ha	A	$\bar{x}$B/ha	B	$\bar{x}$D/ha	A	$\bar{x}$B/ha	B	xD/ha	A	xB/ha	B	$\bar{x}$D/ha	A	$\bar{x}$B/ha	B	$\bar{x}$D/ha	A	$\bar{x}$B/ha	B	$\bar{x}$D/ha	A	$\bar{x}$B/ha	B	Total A	Total B
1N	6,990	5.144	44.55	229.9	11,570	0.157	73.74	11.6	7,030	0.614	7.36	4.5													5.915	245.3
2N	6,990	1.527	44.55	68.0					7,030	1.213	7.36	8.9													2.740	76.9
3N	6,990	2.205	44.55	98.2																					2.205	98.2
1	7,640	5.065	48.69	246.6	11,570	0.472	73.74	34.8	7,030	2.058	7.36	15.1													7.595	296.5
2	7,640	13.280	48.69	646.6	11,570	2.084	73.74	153.7	7,030	1.202	7.36	8.8	14,800	0.210	15.50	3.3									16.776	812.4
3	7,220	5.774	46.01	265.7	11,570	1.155	73.74	85.2																	6.929	350.9
4	7,220	3.632	46.01	167.1	11,570	0.315	73.74	23.2																	3.947	190.3
5	7,220	8.493	46.01	390.8	11,570	1.548	73.74	114.1																	10.041	504.9
6	7,400	3.958	47.16	186.7	11,570	0.331	73.74	24.4	7,030	0.058	7.36	0.4													4.347	211.5
7	7,400	5.459	47.16	257.4	11,570	0.709	73.74	52.3																	6.168	309.7
8	7,400	3.727	47.16	175.8																					3.727	175.8
9																										
10	7,450	1.391	47.48	66.0	11,570	1.123	73.74	82.8																	2.514	148.8
11	7,450	9.810	47.48	465.8	11,570	0.152	73.74	11.2																	9.962	477.0
12	6,990	4.462	44.55	198.8	11,570	0.577	73.74	42.5																	5.039	241.3
13	6,990	6.577	44.55	293.0	11,570	0.367	73.74	27.1	7,030	2.304	7.36	17.0					5,015	0.939	11.37	10.4					10.167	347.5
14	6,990	4.304	44.55	191.7	11,570	0.761	73.74	56.1	7,030	1.365	7.36	10.0					5,015	0.157	11.37	1.8					6.587	259.6
21	5,900	7.640	37.60	287.3	14,780	0.262	94.19	24.7	7,030	0.785	7.36	5.8	14,800	0.942	15.50	14.6									9.629	332.4
22	5,900	16.746	37.60	629.7	14,780	2.303	94.19	216.9																	19.049	846.6
23	5,840	11.722	37.22	436.3	14,780	1.465	94.19	138.0																	13.187	574.3
24	5,840	4.239	37.22	157.8	14,670	0.105	93.49	9.8																	4.344	167.6
25	5,780	15.856	36.84	584.1	14,670	7.536	93.49	704.6																	23.392	1,288.7
26	5,020	9.786	31.99	313.1	14,330	4.710	91.33	430.1																	14.496	743.2
27	5,020	4.762	31.99	152.3	14,330	0.680	91.33	62.1																	5.442	214.4
28	5,170	15.647	32.95	515.5	14,170	4.710	90.31	425.3	7,030	0.471	7.36	3.5													20.828	944.3
29	5,470	12.402	34.86	432.3	14,150	2.617	90.18	236.0	7,030	0.314	7.36	2.3													15.333	670.6
30	5,560	10.780	35.43	382.0	14,150	2.303	90.18	207.7					14,800	0.471	15.50	7.3									13.554	597.0
31	5,250	19.571	33.46	654.8	14,150	3.558	90.18	320.9																	23.129	975.7
32	5,610	9.158	35.75	327.4	14,150	1.308	90.18	118.0																	10.466	445.4
33	5,740	1.622	36.58	59.3	14,150	0.052	90.18	4.7																	1.674	64.0
34	7,090	7.31	45.18	330.3	16,410	3.95	104.58	413.1																	11.26	743.4
35	7,090	6.74	45.18	304.5	16,410	1.02	104.58	106.7																	7.76	411.2
36	7,090	11.74	45.18	530.5	16,410	2.00	104.58	209.2																	13.74	739.7
37	5,610	5.30	35.75	189.5	16,410	1.48	104.58	154.8																	6.78	344.3
38	5,610	4.98	35.75	178.0	16,410	0.68	104.58	71.1																	5.66	249.1
39	5,610	3.15	35.75	112.6	16,410	0.37	104.58	38.7																	3.52	151.3
40	5,610	4.11	35.75	146.9	16,410	2.68	104.58	280.3																	6.79	427.2
41	5,480	2.39	34.92	83.5	16,410	1.39	104.58	145.4																	3.78	228.9
42	5,780	0.06	36.84	2.2																					0.06	2.2
46	5,780	1.42	36.84	52.3	16,410	0.29	104.58	30.3																	1.71	82.6
47	5,780	7.62	36.84	280.7	16,410	1.04	104.58	108.8																	8.66	389.5
48	5,780	1.85	36.84	68.1	16,410	0.52	104.58	54.4																	2.37	122.5
49	5,780	6.96	36.84	256.4	16,410	3.65	104.58	381.7																	10.61	638.1
50	5,780	2.43	36.84	89.5	16,410	0.58	104.58	60.7					14,800	0.25	15.50	3.9									3.26	154.1
Totals		291		11,504		61		5,673		10		76		2		29		1		12		nil		nil	365	17,295

D = Density (no. of plants or fronds)
A = Area (hectares)
B = Biomass (metric tonnes)
$\bar{x}$ = Mean (obtained by averagingonly those blocks containing kelp)
ha = hectare

Table 4. Estimates of kelp area and biomass for the northwest coast of Vancouver Island: Gooding Cove to Rugged Island and Cape Cook to Clerke Point, September 1978. See Charts D and E (Appendix).

	Nereocystis - low density				Nereocystis - high density				Macrocystis - low density				Macrocystis - high density				Mixed - low density				Mixed - high density					
Block	$\bar{x}$D/ha	A	$\bar{x}$B/ha	B	$\bar{x}$D/ha	A	$\bar{x}$B/ha	B	$\bar{x}$D/ha	A	$\bar{x}$B/ha	B	$\bar{x}$D/ha	A	$\bar{x}$B/ha	B	$\bar{x}$D/ha	A	$\bar{x}$B/ha	B	$\bar{x}$D/ha	A	$\bar{x}$B/ha	B	Total A	Total B
51	7,600	3.595	42.70	153.5																					3.595	153.5
52	7,600	3.290	42.70	140.5	16,410	0.270	104.58	28.2	7,030	2.695	7.36	19.8	14,800	0.325	15.50	5.0					17,644	0.110	40.00	4.4	6.690	197.9
53	7,600	1.960	42.70	83.7	16,410	0.855	104.58	89.4	7,030	0.580	7.36	4.3	14,800	0.315	15.50	4.9	5,015	0.300	11.37	3.4					4.010	185.7
54	7,600	1.265	42.70	54.0					7,030	0.555	7.36	4.1	14,800	0.160	15.50	2.5									1.980	60.6
55	7,600	0.145	42.70	6.2	16,410	1.610	104.58	168.4																	1.755	174.6
56	7,600	0.465	42.70	19.9					7,030	0.330	7.36	2.4	14,800	0.535	15.50	8.3									1.330	30.6
57	7,600	1.605	42.70	68.5	16,410	0.030	104.58	3.1	7,030	2.350	7.36	17.3	14,800	0.680	15.50	10.5									4.665	99.4
58	7,600	17.680	42.70	754.9	16,410	1.620	104.58	169.4					14,800	0.188	15.50	2.9									19.488	927.2
59	7,600	13.635	42.70	660.4	16,410	1.015	104.58	106.1	7,030	10.185	7.36	75.0	14,800	6.823	15.50	105.7									31.658	947.2
60	7,600	12.985	42.70	628.9	16,410	0.835	104.58	87.3	7,030	2.600	7.36	19.1	14,800	0.835	15.50	12.9									17.255	748.2
61	6,630	13.205	27.92	368.7	10,750	0.675	45.27	30.6	5,980	6.580	5.14	33.8	19,150	2.150	16.45	35.4									22.610	468.5
62	5,900	8.765	24.84	217.8	10,750	0.310	45.27	14.0	5,980	2.840	5.14	14.6	19,150	0.835	16.45	13.7									12.750	260.1
63	5,900	5.230	24.84	129.9	10,750	0.360	45.27	16.3	5,980	2.705	5.14	13.9					5,015	0.165	11.37	1.9					8.460	162.0
64	5,900	0.135	24.84	3.4					5,980	0.035	5.14	0.2													0.170	3.6
111	7,440	3.109	31.33	97.4																					3.109	97.4
112	7,440	29.283	31.33	917.4	21,380	28.062	90.03	2,526.5																	57.345	3,443.9
113	6,710	21.702	28.26	613.2	16,240	28.392	68.39	1,941.6																	50.094	2,554.8
114	6,850	23.421	28.85	675.6	13,810	11.530	58.15	670.5																	34.951	1,346.1
115	7,100	24.695	29.90	738.3	17,120	6.994	72.09	504.2																	31.689	1,242.5
116	6,120	19.505	25.77	502.7	17,120	11.173	72.09	805.5																	30.678	1,308.2
117	6,890	20.144	29.01	584.5	15,200	8.111	64.01	519.2	5,980	0.897	5.14	4.6													29.152	1,108.3
118	5,400	18.393	22.74	418.2	17,630	10.256	74.24	761.4	5,980	0.514	5.14	2.6					5,015	0.419	11.37	4.8					29.582	1,187.0
119	6,040	17.072	25.43	434.2	14,750	5.269	62.11	327.3	5,980	0.629	5.14	3.2	19,150	0.021	16.45	0.3									22.991	765.0
120	6,000	13.606	25.27	343.8	14,750	2.491	62.11	154.7																	16.097	498.5
121	4,920	19.898	20.72	412.2	14,750	1.599	62.11	99.3																	21.497	511.5
122	4,790	10.722	20.17	216.3																					10.722	216.3
Totals		306		9,244		121		9,023		33		215		13		202		1		10		0		4	474	18,699

D = Density (no. of plants or fronds)
A = Area (hectares)
B = Biomass (metric tonnes)
$\bar{x}$ = Mean (obtainable by averaging only those blocks containing kelp)
ha = Hectare

Table 5. Summary of biomass and kelp bed area estimates, by geographical subdivision and bed type for the northwest coast of Vancouver Island. Estimates are harvestable biomass at MWL ± 0.6 m.

Geographical Area	Blocks	Biomass (tonnes)	Area (hectares)
		Low Density Nereocystis	
Cape Scott to San Joseph Bay	1-14,IN,2N,3N	3947	85
San Joseph Bay to Topknot Point	21-33	4932	140
Topknot Point to Kains Point	34-50	2625	66
Gooding Cove to Rugged Island	51-64	3290	84
Cape Cook to Clerke Point	111-122	5954	222
		High Density Nereocystis	
Cape Scott to San Joseph Bay	1-14,IN,2N,3N	719	10
San Joseph Bay to Topknot Point	21-33	2899	32
Topknot Point to Kains Point	34-50	2055	20
Gooding Cove to Rugged Island	51-64	713	8
Cape Cook to Clerke Point	111-122	8310	114
		Low Density Macrocystis	
Cape Scott to San Joseph Bay	1-14,IN,2N,3N	65	9
San Joseph Bay to Topknot Point	21-33	12	2
Topknot Point to Kains Point	34-50	0	0
Gooding Cove to Rugged Island	51-64	205	31
Cape Cook to Clerke Point	111-122	10	2
		High Density Macrocystis	
Cape Scott to San Joseph Bay	1-14,IN,2N,3N	3	0 (.2)
San Joseph Bay to Topknot Point	21-33	22	1
Topknot Point to Kains Point	34-50	4	0 (.03)
Gooding Cove to Rugged Island	51-64	202	13
Cape Cook to Clerke Point	111-122	0 (.3)	0 (.02)
		Low Density Mixed	
Cape Scott to San Joseph Bay	1-14,IN,2N,3N	12	1
San Joseph Bay to Topknot Point	21-33	0	0
Topknot Point to Kains Point	34-50	0	0
Gooding Cove to Rugged Island	51-64	5	0 (.47)
Cape Cook to Clerke Point	111-122	5	0 (.4)
		High Density Mixed	
Cape Scott to San Joseph Bay	1-14,IN,2N,3N	0	0
San Joseph Bay to Topknot Point	21-33	0	0
Topknot Point to Kains Point	34-50	0	0
Gooding Cove to Rugged Island	51-64	5	0 (.1)
Cape Cook to Clerke Point	111-122	0	0
		Totals	
Cape Scott to San Joseph Bay	1-14,IN,2N,3N	4746	105
San Joseph Bay to Topknot Point	21-33	7865	175
Topknot Point to Kains Point	34-50	4684	86
Gooding Cove to Rugged Island	51-64	4420	136
Cape Cook to Clerke Point	111-122	14279	338
GRAND TOTALS	1-122,IN,2N,3N	35994	840
		Totals by Species	
Nereocystis	1-122,IN,2N,3N	35444	781
Macrocystis	1-122,IN,2N,3N	523	58
Mixed	1-122,IN,2N,3N	27	1

Table 6: Percent composition of low and high density Nereocystis, Macrocystis and mixed bed estimates of biomass in each of five geographic subdivisions. The last column gives percent composition of total biomass for the northwest coast of Vancouver Island.

Bed Type		Cape Scott/ San Joseph	San Joseph/ Topknot Pt.	Topknot/ Kains Pt.	Gooding Cove/ Rugged Is.	Cape Cook/ Clerke Pt.	Combined
Nereocystis	- low density	83.16	62.71	56.04	74.43	41.70	57.64
	- high density	15.15	36.86	43.87	16.13	58.20	40.83
Macrocystis	- low density	1.37	0.15	nil	4.64	0.07	0.81
	- high density	0.06	0.28	0.09	4.57	nil	0.64
Mixed	- low density	0.25	nil	nil	0.11	0.04	0.06
	- high density	nil	nil	nil	0.11	nil	0.01

Table 7: Percent composition of low and high density Nereocystis, Macrocystis and mixed bed estimates of surface area in each of five geographic subdivisions. The last column gives percent composition of total bed area for the northwest coast of Vancouver Island.

Bed Type		Cape Scott/ San Joseph	San Joseph/ Topknot Pt.	Topknot/ Kains Pt.	Gooding Cove/ Rugged Is.	Cape Cook/ Clerke Pt.	Combined
Nereocystis	- low density	80.95	80.00	76.74	61.76	65.68	71.07
	- high density	9.52	18.29	23.26	5.88	33.73	21.90
Macrocystis	- low density	8.57	1.14	nil	22.79	0.59	5.24
	- high density	nil	0.57	nil	9.56	nil	1.67
Mixed	- low density	0.95	nil	nil	nil	nil	0.12
	- high density	nil	nil	nil	nil	nil	nil

Table 8: Combined biomass and density correction factors for cutting levels six metres above and below MWL, used for the northwest coast of Vancouver Island. (Taken from 1976 Nootka Sound Kelp Inventory report. Biomass data was gathered at the end of August, 1975.)

Cutting Level (m)	Nereocystis n = 105	Macrocystis n = 89	Mixed *
+6	-	0.08	0.01
+5	0.05	0.11	0.11
+4	0.13	0.16	0.16
+3	0.30	0.28	0.36
+2	0.48	0.48	0.52
+1	0.70	0.73	0.76
MWL	1.00	1.00	1.00
-1	1.17	1.29	1.17
-2	1.24	1.51	1.29
-3	1.28	1.66	1.35
-4	1.31	1.79	1.42
-5	1.33	1.92	1.48
-6	1.34	2.06	1.54

* Based on 42% Nereocystis and 58% Macrocystis

Table 9: Total harvestable kelp biomass at selected depth levels for the northwest coast of Vancouver Island in September, 1978. (Based on mean plant biomass and vertical biomass distribution data from Nootka Sound, late August, 1975.)

Depth Level (m)	Cumulative Biomass (tonnes)			
	Nereocystis	Marcrocystis	Mixed	Total
+6	-	42	-	42
+5	1,722	58	3	1,833
+4	4,608	84	4	4,696
+3	10,633	146	10	10,789
+2	17,013	251	14	17,278
+1	24,811	382	21	25,214
MWL	35,444	523	27	35,994
-1	41,469	675	32	42,176
-2	43,951	790	35	44,776
-3	45,368	868	36	46,272
-4	46,432	936	38	47,406
-5	47,141	1,004	40	48,185
-6	47,495	1,077	42	48,614

DISCUSSION

The largest kelp beds were located between Clerke Point and Cape Cook off the southwest coast of Brooks Peninsula. This area was surveyed by M.W. Huff and Co. (Huff, 1967), in 1967. Huff's estimate of Nereocystis bed area, density and standing crop are fairly close to our 1978 estimates. He estimated the biomass to be 4.9 kg/m^2 compared to our estimate of 5.9 kg/m^2, and the bed area to be 469 ha compared to the 338 ha found in 1978. At -4 m below MWL (the depth at which their plant samples were collected for biomass), Huff estimated that 25,500 tonnes were available for harvest. Using the combined biomass and density correction factors in Table 8 for -4 m below MWL, the 1978 estimate of available standing crop was 20,254 tonnes. The techniques used by M.W. Huff were not as precise as those of the KIM-1 method; these methods are more fully discussed in Coon et al 1977.

REFERENCES

Coon, L. M. 1977. Marine plant management program in British Columbia. A paper presented at the IXth International Seaweed Symposium at Santa Barbara, California, U.S.A. in August, 1977 (Mimeo). 17 pp.

Coon, L. M., E. J. Field and Canadian Benthic Ltd. 1977. Nootka Sound Kelp inventory, 1975. British Columbia Marine Resources Branch, Fish. Management Rep. No. 2 (2nd Edition). 27 pp.

Coon, L. M., W. Roland, E. J. Field, and W. E. L. Clayton. 1979. Kelp inventory, 1976, Part 3. North and West Coasts Graham Island (Q.C.I.). British Columbia Marine Resources Branch, Fish. Management Rep. No. 13. 26 pp.

Coon, L. M., W. G. Roland, E. J. Field, W. E. L. Clayton, V. Jenson. 1980. Kelp inventory, 1976, Part 4. Goschen Island to the Tree Knob Group. British Columbia Marine Resources Branch, Fish. Management Rep. No. 19. 18 pp.

Coon, L. M., W. G. Roland, E. J. Field, W. E. L. Clayton, V. Jenson. 1981. Kelp inventory, 1976, Part 5. North Vancouver Island, Hope, Nigei and Balaklava Islands. British Columbia Marine Resources Branch, Fish. Management Rep. No. 20. 20 pp.

Field, E. J. and E. A. C. Clark. 1978. Kelp inventory, 1976, Part 2. The Dundas Group. British Columbia Marine Resources Branch, Fish. Management Rep. No. 11. 21 pp.

Field, E. J., L. M. Coon, W. E. L. Clayton and E. A. C. Clark. 1977. Kelp inventory, 1976, Part I. The Estevan Group and Campania Island. British Columbia Marine Resources Branch, Fish. Management Rep. No. 9. 19 pp.

Foreman, R. E. 1975. KIM-1. A method for inventory of floating kelps and its application to selected areas of Kelp Licence Area 12. Benthic Ecological Research Program Report 75-1. Report to Federal Fisheries and Marine Service and Provincial Marine Resources Branch. 81 pp.

Huff, M. W. 1967. A quantitative survey of portions of the east and west coasts of Vancouver Island, British Columbia for species Macrocystis integrifolia and Nereocystis luetkeana. M. W. Huff and Company. 40 pp.

APPENDIX

Charts A through E are enclosed in the following envelope.