Distribution and Abundance of Marbled Murrelets and Common Murres on the Outer Coast of Washington — Summer 1997 through Winter 1998-1999

15 May 1999

Christopher W. Thompson
Washington Department of Fish and Wildlife

For the summers of 1997 and 1998, and winters of 1997-1998 and 1998-1999, the *Tenyo Maru* Trustee's Council (TMTC), U.S. Fish and Wildlife Service, and Washington Department of Natural Resources Funded Washington Department of Fish and Wildlife (WDFW) to complete a variety of specific tasks related to three general objectives: (1) further document the summer and winter at-sea distribution and abundance of Common Murres and Marbled Murrelets along the outer coast of Washington and Strait of Juan de Fuca, (2) conduct surveys of potential Common Murre breeding colonies along the central coast of Washington, and (3) document post-breeding dispersal of of Common Murres from the breeding colonies in Oregon northward along the outer coast of Washington and eastward along the Strait of Juan de Fuca. The specific tasks associated with each of these objectives were completed; analyses of the data collected for each of these tasks are presented and discussed below.

Objective 1: At-sea distribution and abundance of Common Murres and Marbled Murrelets.

Specific tasks funded:

(1) Empirically quantify sampling efficiencies of zig-zag vs. parallel transects
(2) Continue to document long-term seasonal and annual variation in abundance and distribution
(3) Evaluate line vs. strip transect methodology

Task 1

There are two related components to this task: (a) comparison of accuracy and relative statistical power of zig-zag vs. parallel transects for both Common Murres (hereafter murres) and Marbled Murrelets (hereafter murrelets), and (b) determination of the average number of transects necessary to detect a change in density of murres or murrelets of a specified magnitude over a specified time interval (e.g., between seasons, years).

In previous summers and winters, we conducted replicate transects at various distances parallel to shore along the outer coast of Washington and Strait of Juan de Fuca as well as zig-zag transects that covered the range of distances from shore that were covered by parallel transects. To increase our sample size as well as gain additional data on seasonal and annual variation in murrelet density, we collected additional sets of parallel and zig-zag transects in the summers and winters of 1997 and 1998. Our overall survey effort is summarized in Tables 1- 5 below. The data from our parallel and zig-zag transects is summarized in Figures 1-5 and Tables 6 - 8 below.

Table 1. Date, geographic location, and length (kilometers) of transects conducted in the winter of 1996 1997 and associated densities of Marbled Murrelets along the outer coast of Washington and Strait of Juan de Fuca.

Survey Date	Transect Location, Description, and Time	Transect Length (km)	Number of Marbled Murrelets Observed	Density of Marbled Murrelets per km^2
04 February	Port Angeles to Hoko River. 200 M, AM	83.58	24	1.44
04 February	Slip Point to Observatory Point, 400 M, PM	61.84	5	0.40
05 February	Port Angeles to Slip Point, 400 M, AM	71.77	10	0.70
05 February	Slip Point to Port Angeles, 200 M, PM	68.06	8	0.59
06 February	Port Angeles to Slip Point, 800 M, AM	71.56	11	0.77
06 February	Slip Point to Port Angeles, 1200 M, PM	70.69	34	2.40
07 February	Port Angeles to Slip Point, 1200 M, AM	71.27	12	0.84
07 February	Slip Point to Port Angeles, 400 M, PM	71.66	7	0.49
13 February	Neah Bay to Slip Point, 200 M, AM	31.40	44	7.01
13 February	Slip Point to Neah Bay, 400 M, AM	30.10	9	1.50
13 February	Neah Bay to Slip Point (inc.), 200 M, PM	4.88	5	5.12
20 February	Slip Point to Neah Bay, 800 M, AM	29.69	1	0.17
20 February	Neah Bay to Slip Point, 1200 M, PM	27.36	2	0.37
04 March	Gray's Harbor, AM/PM	80.70	2	0.12
05 March	Gray's Harbor, AM/PM	36.62	8	1.09
06 March	Willapa Bay, AM	26.34	0	0
11 March	Ocean Shores to Point Grenville, 1200 M, AM	16.96	0	0
11 March	Point Grenville to Ocean Shores, 200 M, AM	22.43	7	1.56
12 March	Gray's Harbor to Willapa Bay, 1200 M, AM	22.02	1	0.23
20 March	Willapa Bay, high tide, PM	22.93	0	0
20 March	Willapa Bay, low tide, PM	36.14	2	0.28
21 March	Willapa Bay, AM/PM	104.64	17	0.81
25 March	Gray's Harbor to Willapa Bay, 200 M, PM	16.43	1	0.30
25 March	Willapa Bay to Gray's Harbor, 1200 M, PM	15.96	0	0
26 March	Gray's Harbor to Willapa Bay, 200 M, AM	16.02	2	0.62
26 March	Willapa Bay to Gray's Harbor, 1200 M, AM	20.78	8	1.92

Total Kilometers Surveyed: 1131.83

Table 2. Date, geographic location, and length (kilometers) of transects conducted in the summer of 1997 and associated densities of Common Murres and Marbled Murrelets along the outer coast of Washington and Strait of Juan de Fuca.

Survey Date	General Geographic Location	Transect Location	Distance from shore	Time of Day (AM or PM)	Transect Length (km)	Number of Common Murres Observed	Density of Common Murres per Square Km	Number of Marbled Murrelets Observed	Density of Marbled Murrelets per Square Km
11 June	North Coast	Fuca Pillar to Pont of Arches	400 M	AM	10.42	39	18.71	2	0.53
11 June	North Coast	Fuca Pillar to Pont of Arches	Zig-Zag	AM	17.28	140	40.51	5	0.62
12 June	North Coast	Fuca Pillar to Pont of Arches	1000 M	AM	16.06	31	25.22	6	1.19
12 June	North Coast	Fuca Pillar to Point of Arches	400 M	AM	16.98	53	15.61	8	2.56
12 June	North Coast	Fuca Pillar to Point of Arches	700 M	AM	12.52	107	42.73	3	0.35
12 June	North Coast	Fuca Pillar to Point of Arches	Zig-Zag	AM	15.74	37	11.75	7	2.98
12 June	North Coast	Fuca Pillar to Point of Arches	1000 M	PM	13.91	38	13.66	0	0.00
12 June	North Coast	Fuca Pillar to Point of Arches	400 M	PM	16.73	73	21.82	10	2.29
12 June	North Coast	Fuca Pillar to Point of Arches	700 M	PM	12.27	78	31.78	3	0.47
12 June	North Coast	Fuca Pillar to Point of Arches	Zig-Zag	PM	16.41	119	36.26	0	0.00
19 June	South Coast	Columbia R. to Gray's Harbor	Nearshore	AM	82.9	828	49.94	0	0.00
20 June	South Coast	Columbia R. to Gray's Harbor	Offshore	PM	73.03	569	38.96	2	0.26
20 June	South Coast	Columbia R. to Gray's Harbor	Nearshore	AM	75.82	275	18.14	2	0.55
20 June	Gray's Harbor	Gray's Harbor (mouth)		PM	7.81	115	73.62	0	0.00
24 June	North Coast	Fuca Pillar to Point of Arches	1000 M	AM	14.57	138	47.36	0	0.00
24 June	North Coast	Fuca Pillar to Point of Arches	400 M	AM	16.53	102	30.85	6	0.97
24 June	North Coast	Fuca Pillar to Point of Arches	700 M	AM	12.46	44	17.66	2	0.57
24 June	North Coast	Fuca Pillar to Point of Arches	Zig-Zag	AM	17.41	113	32.45	2	0.31
24 June	North Coast	Fuca Pillar to Point of Arches	1000 M	PM	16.1	109	33.85	0	0.00
24 June	North Coast	Fuca Pillar to Point of Arches	400 M	PM	17.08	72	21.08	17	4.03
24 June	North Coast	Fuca Pillar to Point of Arches	700 M	PM	12.81	129	50.35	3	0.30
24 June	North Coast	Fuca Pillar to Point of Arches	Zig-Zag	PM	19.21	144	37.48	2	0.27
25 June	North Coast	Fuca Pillar to Point of Arches	1000 M	PM	14.74	244	82.77	0	0.00
25 June	North Coast	Fuca Pillar to Point of Arches	400 M	PM	16.31	111	34.03	1	0.15
25 June	North Coast	Fuca Pillar to Point of Arches	700 M	AM	12.64	29	11.47	1	0.44
25 June	North Coast	Fuca Pillar to Point of Arches	Zig-Zag	AM	17.93	99	27.61	2	0.36
02 July	Columbia River	Columbia River (mouth)		PM	67.88	52	3.83	0	0.00
02 July	South Coast	Willapa Bay to Columbia R.	Nearshore	AM	70.4	370	26.28	0	0.00
02 July	South Coast	Willapa Bay to Columbia R.	Offshore	PM	51.81	116	11.19	4	1.79
09 July	North Coast	Fuca Pillar to Point of Arches	1000 M	AM	14.07	144	51.17	12	1.17

09 July	North Coast	Fuca Pillar to Point of Arches	400 M	AM	18.08	240	66.37	6	0.45
09 July	North Coast	Fuca Pillar to Point of Arches	700 M	AM	9.42	65	34.50	11	1.59
09 July	North Coast	Fuca Pillar to Point of Arches	Zig-Zag	AM	16.04	277	86.35	15	0.87
09 July	North Coast	Fuca Pillar to Point of Arches	1000 M	PM	14.22	191	67.16	3	0.22
09 July	North Coast	Fuca Pillar to Point of Arches	400 M	PM	16.26	256	78.72	27	1.71
09 July	North Coast	Fuca Pillar to Point of Arches	700 M	PM	10.59	130	61.38	5	0.41
09 July	North Coast	Fuca Pillar to Point of Arches	Zig-Zag	PM	17	224	65.88	14	1.06
10 July	North Coast	Fuca Pillar to Point of Arches	1000 M	AM	14.04	171	60.90	6	0.49
10 July	North Coast	Fuca Pillar to Point of Arches	400 M	AM	11.44	160	69.93	4	0.29
10 July	North Coast	Fuca Pillar to Point of Arches	700 M	AM	13.03	103	39.52	3	0.38
10 July	North Coast	Fuca Pillar to Point of Arches	Zig-Zag	AM	16.82	160	47.56	17	1.79
10 July	North Coast	Fuca Pillar to Point of Arches	1000 M	PM	13.97	93	33.29	12	1.80
10 July	North Coast	Fuca Pillar to Point of Arches	400 M	PM	15.97	92	23.80	27	4.69
15 July	North Coast	Ocean Shores to Pt. Grenville	Nearshore	AM	43.24	238	27.52	34	6.18
15 July	North Coast	Pt. Grenville Grid		AM	46.58	730	78.36	30	1.91
15 July	North Coast	Ocean Shores to Pt. Grenville	Offshore	PM	42.72	150	17.56	7	1.99
16 July	South Coast	Columbia River to Willapa Bay	Offshore	AM	76.34	919	60.19	12	1.00
16 July	Gray's Harbor	Gray's Harbor (mouth)		PM	6.49	24	18.49	0	0.00
17 July	North Coast	Pt. Grenville Grid		AM	42.86	318	37.10	33	4.45
17 July	South Coast	Columbia River to Willapa Bay	Nearshore	PM	75.48	1333	88.30	8	0.45
22 July	Strait	Seal Rock to Kydaka Point	200 M	AM	14.48	1	0.35	30	434.40
22 July	Strait	Seal Rock to Kydaka Point	500 M	AM	14.14	27	9.55	9	4.71
22 July	Strait	Seal Rock to Kydaka Point	800 M	AM	14.39	31	10.77	3	1.39
22 July	Strait	Seal Rock to Kydaka Point	Zig-Zag	PM	16.72	52	15.55	12	3.86
22 July	Strait	Seal Rock to Kydaka Point	200 M	PM	14.4	11	3.82	8	10.47
22 July	Strait	Seal Rock to Kydaka Point	500 M	PM	14.74	9	3.05	1	1.64
22 July	Strait	Seal Rock to Kydaka Point	800 M	PM	14.28	34	11.90	1	0.42
22 July	Strait	Seal Rock to Kydaka Point	Zig-Zag	PM	17.3	52	15.03	0	0.00
23 July	Strait	Seal Rock to Kydaka Point	200 M (inc)	AM	6.1	30	24.59	9	1.83
23 July	Strait	Seal Rock to Kydaka Point	200 M	PM	14.63	324	110.35	9	0.41
23 July	Strait	Seal Rock to Kydaka Point	500 M (inc)	PM	7.33	8	5.46	0	0.00
23 July	Strait	Seal Rock to Kydaka Point	800 M	AM	14.1	256	90.78	2	0.11
23 July	Strait	Seal Rock to Kydaka Point	Zig-Zag	PM	21.03	131	31.15	2	0.32
23 July	Strait	Seal Rock to Kydaka Point	500 M	PM	14.1	69	24.47	1	0.20
24 July	Strait	Seal Rock to Kydaka Point	200 M	AM	15.04	41	13.63	19	6.97
24 July	Strait	Seal Rock to Kydaka Point	500 M	AM	14.33	51	17.79	4	1.12
24 July	Strait	Seal Rock to Kydaka Point	800 M	AM	13.93	42	15.08	0	0.00
24 July	Strait	Seal Rock to Kydaka Point	Zig-Zag	AM	19.68	208	52.85	16	1.51
24 July	Strait	Seal Rock to Kydaka Point	200 M	PM	15.03	14	4.66	23	24.69

24 July	Strait	Seal Rock to Kydaka Point	500 M	AM	14.28	159	55.67	5	0.45
24 July	Strait	Seal Rock to Kydaka Point	800 M	PM	14	29	10.36	0	0.00
24 July	Strait	Seal Rock to Kydaka Point	Zig-Zag	PM	20.78	183	44.03	8	0.91
25 July	Strait	Seal Rock to Kydaka Point	500 M (inc)	AM	10.32	41	19.86	3	0.76
25 July	Strait	Seal Rock to Kydaka Point	800 M	AM	14.05	115	40.93	2	0.24
30 July	South Coast	Columbia River to Willapa Bay	Nearshore	AM	80.88	1451	89.70	2	0.11
30 July	South Coast	Columbia River to Willapa Bay	Offshore	PM	81.09	1147	70.72	1	0.07
31 July	South Coast	Columbia River to Willapa Bay	Offshore	AM	82.91	757	45.65	0	0.00
31 July	South Coast	Columbia River to Willapa Bay	Nearshore	PM	77.06	437	28.35	1	0.18
05 Aug	Strait	Port Angeles to Neah Bay	Nearshore	AM	102.41	32	1.56	293	937.69
06 Aug	North Coast	Lapush to Neah Bay	offshore	PM	80.25	448	27.91	0	0.00
06 Aug	North Coast	Neah Bay to Lapush	nearshore	AM	80.71	392	24.47	20	4.09
07 Aug	Strait	Neah Bay to Port Angeles	Offshore	AM	97.95	372	18.99	35	9.22
12 Aug	South Coast	Columbia River to Willapa Bay	Offshore	PM	77.03	511	33.17	4	0.60
12 Aug	Gray's Harbor	Grays Harbor (mouth)		PM	4.26	1	1.17	0	0.00
12 Aug	South Coast	Columbia River to Willapa Bay	Nearshore	AM	76.79	563	36.66	0	0.00
13 Aug	North Coast	Umatilla to Lapush	Offshore	PM	133.56	89	3.33	6	9.00
13 Aug	North Coast	Lapush to Willapa Bay	Nearshore	AM	161.06	406	12.60	95	37.69
14 Aug	Gray's Harbor	Gray's Harbor (mouth)		PM	8.15	20	12.27	0	0.00
14 Aug	North Coast	Lapush to Willapa Bay	Offshore	AM	124.36	754	30.24	44	7.27
19 Aug	Strait	Port Angeles to Neah Bay	Offshore	AM	97.08	315	16.22	2	0.62
19 Aug	Strait	Seal Rock to Kydaka Point	200 M	PM	14.63	40	13.67	13	4.75
19 Aug	Strait	Seal Rock to Kydaka Point	500 M	PM	15.52	17	5.48	1	0.91
19 Aug	Strait	Seal Rock to Kydaka Point	800 M	PM	14.67	40	13.63	1	0.37
19 Aug	Strait	Seal Rock to Kydaka Point	Zig-Zag	PM	18.58	58	15.28	2	0.65
20 Aug	Strait	Seal Rock to Kydaka Point	500 M	AM	14.59	31	10.34	1	0.48
20 Aug	Strait	Seal Rock to Kydaka Point	Zig-Zag	AM	20.69	67	16.19	4	1.24
20 Aug	Strait	Neah Bay to Port Angeles	Nearshore	PM	102.9	210	10.20	306	149.94
25 Aug	Strait	Seal Rock to Kydaka Point	200 M	AM	14.59	55	18.35	6	1.64
25 Aug	Strait	Seal Rock to Kydaka Point	800 M	AM	13.73	25	9.10	0	0.00
25 Aug	Strait	Seal Rock to Kydaka Point	200 M	PM	14.87	26	8.74	3	1.72
25 Aug	Strait	Seal Rock to Kydaka Point	500 M	PM	14.17	10	3.53	0	0.00
25 Aug	Strait	Seal Rock to Kydaka Point	800 M	PM	13.89	19	6.84	0	0.00
25 Aug	Strait	Seal Rock to Kydaka Point	Zig-Zag	AM	20.6	25	6.07	3	2.47
28 Aug	North Coast	Line 1[1] (first part)			28.61	15	2.62	0	0.00
29 Aug	North Coast	Line 1 (completion)			50.42	28	2.78	0	0.00
30 Aug	North Coast	Line 7			4.87	0	0.00	0	0.00
30 Aug	North Coast	Line 8			6.12	1	0.82	0	0.00
30 Aug	North Coast	Line 9			8.33	4	2.40	0	0.00

30 Aug	North Coast	Line 10	6.49	10	7.70	0	0.00
30 Aug	North Coast	Line 11	10.16	11	5.41	0	0.00
30 Aug	North Coast	Line 12	7.35	1	0.68	0	0.00
31 Aug	South Coast	Line 13	44.08	194	22.01	0	0.00
1 Sept	South Coast	Line 14	47.61	41	4.31	0	0.00
1 Sept	South Coast	Line 15	11.07	0	0.00	0	0.00
2 Sept	South Coast	Line 16	36.02	12	1.67	0	0.00
2 Sept	South Coast	Line 17	4.89	0	0.00	0	0.00
2 Sept	South Coast	Line 18	23.07	20	4.33	0	0.00
3 Sept	South Coast	Line 19	18.4	18	4.89	0	0.00
3 Sept	South Coast	Line 20	6.51	0	0.00	0	0.00
3 Sept	South Coast	Line 21	17.89	19	5.31	0	0.00
3 Sept	South Coast	Line 22	6.19	11	8.89	0	0.00
3 Sept	South Coast	Line 23	22.51	18	4.00	0	0.00
4 Sept	South Coast	Line 24	26.81	34	6.34	0	0.00
4 Sept	South Coast	Line 25	5.99	1	0.83	0	0.00
4 Sept	South Coast	Line 26	22.54	29	6.43	0	0.00
5 Sept	South Coast	Line 27	31.59	26	4.12	0	0.00
5 Sept	South Coast	Line 28	20.29	66	16.26	0	0.00
6 Sept	South Coast	Line 29	13.73	16	5.83	0	0.00
6 Sept	South Coast	Line 30	42.83	64	7.46	0	0.00
7 Sept	South Coast	Line 31	19.53	80	20.48	0	0.00
7 Sept	South Coast	Line 32	5.6	2	1.79	0	0.00
7 Sept	South Coast	Line 33	20.43	44	10.77	0	0.00
8 Sept	South Coast	Line 34	21	14	3.33	0	0.00
8 Sept	South Coast	Line 35	5.62	0	0.00	0	0.00
8 Sept	South Coast	Line 36	21.96	17	3.37	0	0.00
9 Sept	South Coast	Line 37	23.41	9	1.92	0	0.00
9 Sept	South Coast	Line 38	20.73	6	1.45	0	0.00
10 Sept	South Coast	Line 39	81.36	288	17.70	0	0.00
12 Sept	South Coast	Line 40	5.94	0	0.00	0	0.00
12 Sept	South Coast	Line 41	25.08	20	3.99	0	0.00
12 Sept	South Coast	Line 42	5.71	1	0.88	0	0.00
12 Sept	South Coast	Line 43	24.4	17	3.48	0	0.00
13 Sept	South Coast	Line 44	2.33	5	10.73	0	0.00
13 Sept	South Coast	Line 45	15.97	2	0.63	0	0.00
13 Sept	South Coast	Line 46	21.78	15	3.44	1	1.45
13 Sept	South Coast	Line 47	23.68	22	4.65	0	0.00

Total Kilometers Surveyed: 4178.48

[1] These line numbers refer to transects approximately parallel and perpendicular to shore conducted by the U.S. Geological Survey as part of a study of nearshore bathymetry along the outer coast of northern Oregon and southern Washington.

Table 3. Date, geographic location, and length (kilometers) of transects conducted in the winter of 1997-1998 and associated densities of Common Murres and Marbled Murrelets along the outer coast of Washington and Strait of Juan de Fuca.

Survey Date	Location	Transect Length (km)	Number of Common Murres	Common Murre Density per sq. km	Number of Marbled Murrelets	Marbled Murrelet Density per sq. km
22 January 1998	Seal/Sail Rock to Kydaka Point, 200 M, AM	15.52	1	0.32	10	3.22
"	Seal/Sail Rock to Kydaka Point, 500 M, AM	15.11	10	3.31	10	3.31
27 January 1998	Seal/Sail Rock to Kydaka Point, 200 M, AM	15.98	1	0.31	5	1.56
"	Seal/Sail Rock to Kydaka Point, 500 M, PM	13.98	29	10.37	10	3.58
"	Seal/Sail Rock to Kydaka Point, 800 M, AM	14.07	20	7.11	1	0.36
"	Seal/Sail Rock to Kydaka Point, Zig-Zag, AM	20.62	24	5.82	10	2.42
29 January 1998	Seal/Sail Rock to Kydaka Point, 200 M, AM	15.22	1	0.33	32	10.51
"	Seal/Sail Rock to Kydaka Point, 500 M, AM	14.62	5	1.71	19	6.50
"	Seal/Sail Rock to Kydaka Point, 800 M, AM	14.08	19	6.75	7	2.49
"	Seal/Sail Rock to Kydaka Point, Zig-Zag, AM	21.33	9	2.11	26	6.00
"	Seal/Sail Rock to Kydaka Point, 200 M, PM	15.42	2	0.65	33	10.70
"	Seal/Sail Rock to Kydaka Point, 500 M, PM	14.54	8	2.75	48	16.51
"	Seal/Sail Rock to Kydaka Point 800 M, PM	13.98	24	8.58	1	0.36
"	Seal/Sail Rock to Kydaka Point, Zig-Zag, PM	21.81	58	13.30	28	6.42
4 February 1998	Seal/Sail Rock to Kydaka Point, 200 M, PM	15.65	0	0.00	5	1.60
"	Seal/Sail Rock to Kydaka Point, Zig-Zag, PM	21.13	1	0.24	11	2.60
5 February 1998	Seal/Sail Rock to Kydaka Point, 500 M, AM	15.13	0	0.00	10	3.30
"	Seal/Sail Rock to Kydaka Point, 800 M, AM	13.9	10	3.60	0	0.00
"	Seal/Sail Rock to Kydaka Point, Zig-Zag, AM	35.8	6	0.84	4	0.56
"	Seal/Sail Rock to Kydaka Point, 200 M, PM	15.75	0	0.00	8	2.54
"	Seal/Sail Rock to Kydaka Point, 500 M, PM	15.14	0	0.00	21	6.94
"	Seal/Sail Rock to Kydaka Point, 800 M, PM	14.74	1	0.34	2	0.68
"	Seal/Sail Rock to Kydaka Point, Zig-Zag, PM	24.03	0	0.00	11	2.29
11 February 1998	Seal/Sail Rock to Kydaka Point, 500 M, AM	16.15	1	0.31	20	6.19
"	Seal/Sail Rock to Kydaka Point, 800 M, AM	15.57	6	1.93	17	5.46
"	Seal/Sail Rock to Kydaka Point, Zig-Zag, AM	22.93	14	3.05	26	5.67
"	Seal/Sail Rock to Kydaka Point, 200 M, PM	16.41	3	0.91	3	0.91
"	Seal/Sail Rock to Kydaka Point, 200 M, PM	15.9	1	0.31	0	0.00
"	Seal/Sail Rock to Kydaka Point, 500 M, PM	16.12	4	1.24	25	7.75
"	Seal/Sail Rock to Kydaka Point, 800 M, PM	14.74	1	0.34	2	0.68
"	Seal/Sail Rock to Kydaka Point, Zig-Zag, PM	23.66	28	5.92	25	5.28
17 February 1998	Fuca Pillar to Point of Arches, 1000 M, AM	14.1	76	26.95	12	4.26
"	Fuca Pillar to Point of Arches, 700 M, AM	12.55	32	12.75	7	2.79
"	Fuca Pillar to Point of Arches (Partial), 700 M, AM	9.45	152	80.42	9	4.76
"	Tatoosh Island to Seal/Sail Rock, 1000 M, PM	17.37	1790	515.26	25	7.20
"	Tatoosh Island to Seal/Sail Rock, 500 M, AM	17.09	58	16.97	25	7.31
18 February 1998	Kydaka Point to Waadah Island, 1000 M, PM	4.39	1	1.14	2	2.28
"	Sekul to Port Angeles, 1000 M, PM	80.04	17	1.06	119	7.43
"	Sekui to Port Angeles, 500 M, AM	81.43	2	0.12	60	3.68
19 February 1998	Majestic Beach (nr Lyre R.) to Tatoosh Is., 880 M, PM	76.51	674	44.05	89	5.82

"	Tatoosh Island to Seal/Sail Rock, 400 M, AM	77.72	3009	193.58	220	14.15
24 February 1998	Fuca Pillar to Point of Arches, 1000 M, AM	14.5	0	0.00	13	4.48
"	Fuca Pillar to Point of Arches, 1000 M, AM	13.78	0	0.00	14	5.08
"	Fuca Pillar to Point of Arches, 1000 M, PM	13.65	0	0.00	17	6.23
"	Fuca Pillar to Point of Arches, 1000 M, PM	14	6	2.14	14	5.00
"	Fuca Pillar to Point of Arches, 1000 M, PM	14.04	1	0.36	27	9.62
"	Fuca Pillar to Point of Arches, 200 M, AM	12.72	0	0.00	10	3.93
"	Fuca Pillar to Point of Arches, 700 M, AM	13.9	0	0.00	23	8.27
"	Fuca Pillar to Point of Arches, 700 M, AM	13.07	1	0.38	23	8.80
"	Fuca Pillar to Point of Arches, 700 M, PM	12.32	10	4.06	16	6.49
"	Fuca Pillar to Point of Arches, , 700 M, PM	13.42	2	0.75	11	4.10
25 February 1998	Slip Point to Crescent Bay, 1200 M, AM	42.01	18	2.14	16	1.90
	Fuca Pillar to Point of Arches, 1000 M, PM	14.96	2	0.67	14	4.68
"	Fuca Pillar to Point of Arches, 1000 M, AM	14.36	3	1.04	15	5.22
"	Fuca Pillar to Point of Arches, 1000 M, PM	16.37	10	3.05	6	1.83
"	Fuca Pillar to Point of Arches, 700 M, AM	10.88	4	1.84	15	6.89
"	Fuca Pillar to Point of Arches, 700 M, PM	12.56	0	0.00	19	7.56
"	Fuca Pillar to Point of Arches, 700 M, PM	12.98	2	0.77	17	6.55
"	Skagway Rocks to Neah Bay, 700 M, PM	15.79	72	22.80	94	29.77
3 March 1998	Point of Arches to Quilleute River, nearshore, AM	55.76	60	6.19	59	5.29
"	Point of Arches to Skagway Rocks, offshore, PM	14.09	7	2.48	10	3.55
"	Quilleute River to Point of Arches, offshore, PM	47.11	864	91.70	36	3.82
"	Skagway Rocks to Neah Bay, offshore, PM	18.05	207	54.02	15	3.96
4 March 1998	Neah Bay to Port Angeles, 1700 M, AM	98.42	583	29.62	38	1.93
"	Port Angeles to Neah Bay, 400 M, PM	100.84	20	0.99	139	6.89
5 March 1998	Neah Bay to Skagway Rocks, nearshore, AM	16.22	9	2.77	32	9.86
"	Point of Arches to Skagway Rocks, 400 M, AM	15.94	0	0.00	23	7.21
"	Point of Arches to Skagway Rocks, 400 M, AM	15.94	0	0.00	8	2.51
"	Point of Arches to Skagway Rocks, 400 M, AM	16.21	1	0.31	7	2.16
"	Neah Bay to Skagway Rocks, nearshore, PM	15.91	4	1.26	25	7.86
"	Point of Arches to Skagway Rocks, 400 M, AM	16.49	0	0.00	20	6.06
10 March 1998	Ocean Shores to Point Grenville, nearshore, AM	49.01	203	26.63	32	3.26
	Westport to Willapa Bay, nearshore, AM	38.95	40	5.13	55	7.06
"	Willapa Bay to Columbia River, nearshore, AM	41.84	46	5.50	81	9.68
"	Columbia River to Willapa Bay, offshore, PM	42.91	329	38.34	197	22.96
"	Willapa Bay to Westport, offshore, PM	39.12	63	8.05	73	9.33
13 March 1998	Outside Gray's Harbor seawall	56.15	6	0.53	67	5.97
17 March 1998	Around Destruction Island	8.35	0	0.00	3	1.80
"	Pt. Grenville to Hoh Head, first half, offshore, AM	47.24	5	0.53	4	0.42
"	Pt. Grenville to Hoh Head, second half, offshore, AM	9.66	0	0.00	0	0.00
"	Hoh Head to Point Grenville, nearshore, PM	57.45	10	0.87	0	0.00
18 March 1998	Inside Willapa Bay	82.98	0	0.00	32	1.93
"	Inside Willapa Bay	41	2	0.24	24	2.93
19 March 1998	Hoh Head to Lapush, nearshore, AM	24.87	0	0.00	0	0.00
"	Lapush to Hoh Head, offshore, AM	19.24	82	21.31	3	0.78
"	Pt. Grenville to Gray's Harbor, offshore, PM	46.61	73	7.83	5	0.54
	Total Kilometers surveyed:	2242.25				

Table 4. Date, geographic location, and length (kilometers) of transects conducted in the summer of 1998 and associated densities of Common Murres and Marbled Murrelets along the outer coast of Washington and Strait of Juan de Fuca.

SURVEY DATE	Location	Transect Length (km)	Number of Common Murres	Common Murre Density per sq. km	Number of Common Murre Chicks	Common Murre Chick Density per sq. km	Number of Marbled Murrelets	Marbled Murrelet Density per sq. km
2 June 1998	Kydaka Point to Pillar Point, 400 M AM	20.15	0	0.00	0	0.00	11	2.73
"	Neah Bay to Kydaka Point, 400 M, AM	21.2	9	2.12	0	0.00	26	6.13
2 June 1998	Low Point to Pillar Point, 400 M, PM	21.45	23	5.36	0	0.00	109	25.41
"	Pillar Point to Low Point, 400 M, PM	22.58	0	0.00	0	0.00	30	6.64
3 June 1998	Point of Arches to Skagway Rocks, 700 meters	12.52	97	38.74	0	0.00	2	0.80
"	Skagway Rocks to Neah Bay, nearshore	15.59	43	13.79	0	0.00	2	0.64
"	Point of Arches to Skagway Rocks, 400 meters	16.49	36	10.92	0	0.00	6	1.82
4 June 1998	Kydaka Point to Pillar Point, nearshore	22.06	1	0.23	0	0.00	17	3.85
"	Neah Bay to Kydaka Point, rearshore	19.7	7	1.78	0	0.00	32	8.12
4 June 1998	Kydaka Point to Neah Bay, offshore	19.88	16	4.02	0	0.00	22	5.53
"	Pillar Point to Kydaka Point, offshore	22.63	6	1.33	0	0.00	4	0.88
4 June 1998	Kydaka Point to Pillar Point, offshore	20.46	4	0.98	0	0.00	4	0.98
"	Neah Bay to Kydaka Point, offshore	21.07	16	3.80	0	0.00	17	4.03
4 June 1998	Kydaka Point to Neah Bay, nearshore	19.91	12	3.01	0	0.00	27	6.78
"	Pillar Point to Neah Bay, nearshore	23.05	1	0.22	0	0.00	10	2.17
9 June 1998	Gray's Harbor - Willapa Bay, nearshore	30.31	1185	195.48	0	0.00	4	0.66
"	Klipson Beach - Columbia River, nearshore	20.58	1386	336.73	0	0.00	1	0.24
"	Willapa Bay to Klipson Beach, nearshore	31.44	6078	966.60	0	0.00	0	0.00
9 June 1998	Columbia River - Klipson Beach, offshore	23.19	1671	360.28	0	0.00	0	0.00
"	Klipson Beach - Willapa Bay, offshore	28.47	1215	213.38	0	0.00	0	0.00
"	Willapa Bay - Gray's Harbor, offshore	33.2	1322	199.10	0	0.00	0	0.00
10 June 1998	Gray's Harbor - Willapa Bay, offshore	18.99	1811	476.83	0	0.00	1	0.26
11 June 1998	Gray's Harbor - Willapa Bay, offshore	27.23	892	163.79	0	0.00	0	0.00
"	Klipson Beach - Columbia River, offshore	18.8	2133	567.29	0	0.00	1	0.27
"	Willapa Bay - Klipson Beach, offshore	30.51	412	67.52	0	0.00	1	0.16
11 June 1998	Columbia River - Klipson Beach, nearshore	19.31	6571	1701.45	0	0.00	0	0.00
"	Klipson Beach - Willapa Bay, nearshore	29	1196	206.2[illegible]	0	0.00	2	0.34
"	Willapa Bay - Gray's Harbor, nearshore	27.01	165	30.54	0	0.00	0	0.00

16 June 1998	Seal/Sail Rock to Kydaka PT., 200 M, AM	15.15	0	0.00	0	0.00	129	42.57
"	Seal/Sail Rock to Kydaka PT., 500 M, AM	14.41	10	3.47	0	0.00	41	14.23
"	Seal/Sail Rock to Kydaka PT., 800 M, AM	13.81	9	3.26	0	0.00	0	0.00
"	Seal/Sail Rock to Kydaka PT., Zig-Zag, AM	21.34	16	3.75	0	0.00	74	17.34
16 June 1998	Seal/Sail Rock to Kydaka PT., 200 M, PM	15.72	1	0.32	0	0.00	93	29.58
"	Seal/Sail Rock to Kydaka PT., 500 M, AM	14.43	4	1.39	0	0.00	8	2.77
"	Seal/Sail Rock to Kydaka PT., 800 M, PM	8.75	54	30.86	0	0.00	0	0.00
17 June 1998	Seal/Sail Rock to Kydaka PT., 200 M, AM	15.01	3	1.00	0	0.00	126	41.97
"	Seal/Sail Rock to Kydaka PT., 500 M, AM	14.43	1	0.35	0	0.00	56	19.40
"	Seal/Sail Rock to Kydaka PT., 800 M, AM	13.99	19	6.79	0	0.00	11	3.93
"	Seal/Sail Rock to Kydaka PT., Zig-Zag, AM	20.89	20	4.79	0	0.00	70	16.75
17 June 1998	Seal/Sail Rock to Kydaka PT., 200 M, PM	15.06	4	1.33	0	0.00	125	41.50
"	Seal/Sail Rock to Kydaka PT., 500 M, PM	14.5	12	4.14	0	0.00	15	5.17
"	Seal/Sail Rock to Kydaka PT., 800 M, AM	13.98	9	3.22	0	0.00	4	1.43
"	Seal/Sail Rock to Kydaka PT., Zig-Zag, PM	20.36	14	3.44	0	0.00	50	12.28
18 June 1998	Seal/Sail Rock to Kydaka PT., 200 M, AM	15.25	3	0.98	0	0.00	239	78.36
"	Seal/Sail Rock to Kydaka PT., 500 M, AM	14.33	7	2.44	0	0.00	32	11.17
"	Seal/Sail Rock to Kydaka PT., 800 M, AM	14.3	5	1.75	0	0.00	2	0.70
"	Seal/Sail Rock to Kydaka PT., Zig-Zag, AM	21.49	17	3.96	0	0.00	40	9.31
18 June 1998	Seal/Sail Rock to Kydaka PT., 200 M, PM	15.11	4	1.32	0	0.00	195	64.53
"	Seal/Sail Rock to Kydaka PT., 500 M, PM	14.64	6	2.05	0	0.00	7	2.39
"	Seal/Sail Rock to Kydaka PT., 200 M, PM	13.77	35	12.71	0	0.00	6	2.18
"	Seal/Sail Rock to Kydaka PT., Zig-Zag, PM	21.28	24	5.64	0	0.00	36	8.46
23 June 1998	Low Point to Pillar Point, nearshore	22.92	16	3.49	0	0.00	302	65.88
"	Observatory Point to Low Point, nearshore	15.67	2	0.64	0	0.00	70	22.34
"	Port Angeles to Observatory Point, nearshore	19.75	25	6.33	0	0.00	111	28.10
"	Pillar Point to Kydaka Point, nearshore	23.38	1	0.21	0	0.00	111	23.74
23 June 1998	Kydaka Point to Pillar Point, offshore	25.8	21	4.07	0	0.00	44	8.53
"	Low Point to Observatory Point, offshore	15.67	1	0.32	0	0.00	15	4.79
"	Observatory Point to Port Angeles, offshore	20.17	15	3.72	0	0.00	45	11.16
"	Pillar Point to Low Point, offshore	19.46	20	5.14	0	0.00	120	30.83
24 June 1998	Low Point to Pillar Point, offshore	22.33	8	1.79	0	0.00	136	30.45
"	Observatory Point to Low Point, offshore	15.73	1	0.32	0	0.00	47	14.94
"	Port Angeles to Observatory Point, offshore	19.48	4	1.03	0	0.00	72	18.48
24 June 1998	Kydaka Point to Pillar Point, nearshore	23.75	5	1.05	0	0.00	130	27.37

"	Low Point to Observatory Point, nearshore	15.89	1	0.31	0	0.00	93	29.26
"	Observatory Point to Port Angeles, nearshore	19.33	0	0.00	0	0.00	271	70.10
"	Pillar Point to Low Point, nearshore	22.68	8	1.76	0	0.00	283	62.39
25 June 1998	Kydaka Point to Pillar Point, nearshore	23.7	2	0.42	0	0.00	167	35.23
"	Low Point to Observatory Point, nearshore	15.99	0	0.00	0	0.00	86	26.89
"	Observatory Point to Port Angeles, nearshore	20.2	6	1.49	0	0.00	183	45.30
"	Pillar Point to Low Point, nearshore	22.77	5	1.10	0	0.00	268	58.85
30 June 1998	Columbia River - Klipson Beach, nearshore	22.62	1955	432.14	0	0.00	2	0.44
"	Gray's Harbor - Willapa Bay, offshore	26.71	229	42.87	0	0.00	4	0.75
"	Klipson Beach - Columbia River, offshore	22.06	5408	1225.75	0	0.00	3	0.68
"	Klipson Beach - Willapa Bay, nearshore	31.41	765	121.73	0	0.00	7	1.11
"	Willapa Bay - Gray's Harbor, nearshore	32.65	28	4.29	0	0.00	0	0.00
"	Willapa Bay - Klipson Beach, offshore	30.15	902	149.59	0	0.00	4	0.66
1 July 1998	Columbia River - Klipson Beach, offshore	22.25	2607	585.84	0	0.00	7	1.57
"	Gray's Harbor - Willapa Bay, nearshore	24.53	368	75.01	0	0.00	0	0.00
"	Klipson Beach - Columbia River, nearshore	21.18	1950	460.34	0	0.00	3	0.71
"	Klipson Beach - Willapa Bay, offshore	29.86	961	160.92	0	0.00	2	0.33
"	Willapa Bay - Gray's Harbor, offshore	25.14	250	49.72	0	0.00	3	0.60
"	Willapa Bay - Klipson Beach, nearshore	32.91	575	87.36	0	0.00	2	0.30
7 July 1998	Outer Coast, Neah Bay south, 1000M, AM	14.35	96	33.45	0	0.00	2	0.70
"	Outer Coast, Neah Bay south, 400M, AM	17.61	310	88.02	0	0.00	20	5.68
"	Outer Coast, Neah Bay south, 700M, AM	12.44	89	35.77	0	0.00	3	1.21
"	Outer Coast, Neah Bay south, Zig-Zag, AM	17.57	75	21.34	0	0.00	0	0.00
"	Outer Coast, Neah Bay south, 1000M, PM	14.22	146	51.34	0	0.00	0	0.00
"	Outer Coast, Neah Bay south 400M, AM	17.14	126	36.76	0	0.00	11	3.21
"	Outer Coast, Neah Bay south 700M, PM	12.61	212	84.06	0	0.00	0	0.00
"	Outer Coast, Neah Bay south Zig-Zag, AM	18.42	111	30.13	0	0.00	0	0.00
"	Kydaka Point to Pillar Point, nearshore	23.18	6	1.29	0	0.00	78	16.82
"	Low Point to Observatory Point, nearshore	17.77	49	13.79	0	0.00	181	50.93
"	Neah Bay to Kydaka Point, nearshore	21.15	149	35.22	0	0.00	192	45.39
"	Observatory Point to Port Angeles, nearshore	19.88	21	5.28	0	0.00	97	24.40
"	Pillar Point to Low Point, nearshore	22.67	21	4.63	0	0.00	420	92.63
9 July 1998	Outer Coast, Neah Bay south, 1000M, PM	13.67	38	13.90	0	0.00	0	0.00
"	Outer Coast, Neah Bay south, 400M, AM	16.61	36	10.84	0	0.00	22	6.62
"	Outer Coast, Neah Bay south, 700M, PM	12.8	42	16.41	0	0.00	5	1.95

"	Outer Coast, Neah Bay south, Zig-Zag, AM	18.43	41	11.12	0	0.00	4	1.09
16 July 1998	Columbia River - Klipson Beach, offshore	22.94	804	175.24	9	1.96	0	0.00
"	Gray's Harbor - Willapa Bay, nearshore	23.15	652	140.82	6	1.30	0	0.00
"	Klipson Beach - Columbia River, nearshore	21.07	981	232.80	14	3.32	1	0.24
"	Klipson Beach - Willapa Bay, offshore	34.69	489	70.48	2	0.29	2	0.29
"	Willapa Bay - Gray's Harbor, offshore	22.86	412	90.11	4	0.87	0	0.00
"	Willapa Bay - Klipson Beach, nearshore	32.47	1695	261.01	14	2.16	2	0.31
21 July 1998	Seal/Sail Rock to Kydaka PT., 200 M, AM	14.63	26	8.89	0	0.00	54	13.46
"	Seal/Sail Rock to Kydaka PT., 500 M, AM	13.89	91	32.76	0	0.00	13	4.68
"	Seal/Sail Rock to Kydaka PT., 800 M, PM	14.18	112	39.49	0	0.00	2	0.71
"	Seal/Sail Rock to Kydaka PT., Zig-Zag, AM	21.95	194	44.19	0	0.00	31	7.06
21 July 1998	Seal/Sail Rock to Kydaka PT., 200 M, PM	15.56	112	35.99	0	0.00	32	10.28
"	Seal/Sail Rock to Kydaka PT., 500 M, PM	14.48	31	10.70	0	0.00	19	6.56
"	Seal/Sail Rock to Kydaka PT., 800 M, PM	14.57	57	19.56	0	0.00	3	1.03
"	Seal/Sail Rock to Kydaka PT., Zig-Zag, PM	22.57	186	41.21	0	0.00	27	5.98
22 July 1998	Seal/Sail Rock to Kydaka PT., 200 M, AM	15.57	22	7.06	0	0.00	43	13.81
"	Seal/Sail Rock to Kydaka PT., 500 M, AM	14.23	94	33.03	0	0.00	5	1.76
"	Seal/Sail Rock to Kydaka PT., 800 M, AM	13.27	181	68.20	0	0.00	4	1.51
"	Seal/Sail Rock to Kydaka PT., Zig-Zag, AM	21.5	395	91.86	0	0.00	24	5.58
23 July 1998	Outer Coast, Neah Bay south, 400M, AM	16.4	49	14.94	0	0.00	6	1.83
"	Outer Coast, Neah Bay south, 700M, AM	12.57	31	12.33	0	0.00	3	1.19
"	Outer Coast, Neah Bay south, 1000M, AM	14.19	42	14.80	0	0.00	1	0.35
"	Outer Coast, Neah Bay south, Zig-Zag, AM	16.59	177	53.35	0	0.00	5	1.51
28 July 1998	Columbia River - Klipson Beach, offshore	21.77	1371	314.88	7	1.61	0	0.00
"	Gray's Harbor - Willapa Bay, nearshore	24.98	1222	244.60	13	2.60	0	0.00
"	Klipson Beach - Columbia River, nearshore	21.8	1569	359.86	74	16.97	2	0.46
"	Klipson Beach - Willapa Bay, offshore	26.01	401	77.09	18	3.46	2	0.38
"	Willapa Bay - Gray's Harbor, offshore	41.37	375	45.32	6	0.73	0	0.00
"	Willapa Bay - Klipson Beach, nearshore	30.91	1776	287.29	50	8.09	2	0.32
30 July 1998	Cape Alava to Point of Arches, nearshore	19.15	139	36.29	3	0.78	11	2.87
"	Cape Alava to Quilleute River, offshore	35.12	531	75.60	15	2.14	1	0.14
"	Point of Arches to Cape Alava, offshore	16.16	142	43.94	1	0.31	0	0.00
"	Quilleute River to Cape Alava, nearshore	32.97	215	32.61	4	0.61	1	0.15
11 Aug 1998	Neah Bay to Kydaka Point, nearshore	19.63	4	1.02	0	0.00	10	2.55

11 Aug 1998	Kydaka Point to Pillar Point, nearshore	22.93	1	0.22	0	0.00	7	1.53
12 Aug 1998	Low Point to Observation Point, nearshore	15.95	2	0.63	0	0.00	33	10.34
"	Low Point to Pillar Point, offshore	18.57	8	2.15	0	0.00	5	1.35
"	Observatory Point to Low Point, offshore	7.97	1	0.63	0	0.00	0	0.00
"	Observatory Point to Port Angeles, nearshore	18.15	9	2.48	1	0.28	18	4.96
"	Port Angeles to Observatory Point, offshore	16.22	101	31.13	2	0.62	1	0.31
"	Pillar Point to Low Point, nearshore	22.55	3	0.67	0	0.00	111	24.61
13 Aug 1998	Kydaka Point to Pillar Point, nearshore	20.52	0	0.00	0	0.00	9	2.19
"	Neah Bay to Kydaka Point, nearshore	20.86	12	2.88	0	0.00	11	2.64
"	Pillar Point to Low Point, nearshore	24.46	0	0.00	0	0.00	182	37.20
13 Aug 1998	Low Point to Pillar Point, offshore	22.21	3	0.68	0	0.00	85	19.14
"	Slip Point to Neah Bay, nearshore	30.15	8	1.33	0	0.00	16	2.65
26 Aug 1998	Kydaka Point to Neah Bay, Zig-Zag	25.47	25	4.91	2	0.39	0	0.00
"	Low Point to Pillar Point, Zig-Zag	25.19	41	8.14	2	0.40	17	3.37
"	Observatory Point to Low Point, Zig-Zag	20.29	41	10.10	3	0.74	3	0.74
"	Port Angeles to Observatory Point, Zig-Zag	25.07	41	8.18	3	0.60	4	0.80
"	Pillar Point to Kydaka Point, Zig-Zag	26.71	24	4.49	4	0.75	1	0.19
27 Aug 1998	Cape Alava to Jagged Island, nearshore	31.34	14	2.23	2	0.32	6	0.96
"	Cape Alava to Point of Arches, offshore	11.85	101	42.62	8	3.38	1	0.42
"	Fuca Pillar to Neah Bay, offshore	17.86	117	32.75	3	0.84	0	0.00
"	Fuca Pillar to Point of Arches, nearshore	18.84	22	5.84	1	0.27	3	0.80
"	Jagged Island to Cape Alava, offshore	24.51	43	8.77	9	1.84	0	0.00
"	Neah Bay to Fuca Pillar, nearshore	14.69	39	13.27	4	1.36	3	1.02
"	Point of Arches to Cape Alava, nearshore	13.08	8	3.06	0	0.00	6	2.29
"	Point of Arches to Fuca Pillar, offshore	17.46	33	9.45	4	1.15	4	1.15
28 Aug 1998	Kydaka Point to Pillar Point, Zig-Zag	29.31	17	2.90	1	0.17	0	0.00
"	Low Point to Observatory Point, Zig-Zag	20.28	70	17.26	3	0.74	2	0.49
"	Neah Bay to Kydaka Point, Zig-Zag	25.41	31	6.10	2	0.39	3	0.59
"	Observatory Point to Port Angeles, Zig-Zag	25.49	56	10.98	7	1.37	4	0.78
"	Pillar Point to Low Point, Zig-Zag	38.62	95	12.30	5	0.65	45	5.83
1 Sept 1998	Kydaka Point to Pillar Point, Zig-Zag	19.5	2	0.51	0	0.00	0	0.00
"	Neah Bay to Kydaka Point, Zig-Zag	22.98	9	1.96	1	0.22	6	1.31
1 Sept 1998	Fuca Pillar to Point of Arches, 400 M, PM	46.21	49	5.30	0	0.00	0	0.00
"	Neah Bay to Fuca Pillar, Zig-Zag	10.36	13	6.27	0	0.00	0	0.00

2 Sept 1998	Kydaka Point to Pillar Point, Zig-Zag	1.43	16	55.94	2	6.99	1	3.50
"	Low Point to Observatory Point, Zig-Zag	7.21	4	2.77	0	0.00	0	0.00
"	Pillar Point to Low Point, Zig-Zag	15.41	16	5.19	0	0.00	0	0.00
2 Sept 1998	Low Point to Observatory Point, Zig-Zag	7.46	3	2.01	0	0.00	2	1.34
"	Observatory Point to Port Angeles, Zig-Zag	20.75	3	0.72	0	0.00	2	0.48
	Total Kilometers Surveyed:	3501.96						

Table 5. Date, geographic location, and length (kilometers) of transects conducted in the winter of 1998-1999 and associated densities of Common Murres and Marbled Murrelets along the Strait of Juan de Fuca.

Survey Date	Transect Location	Distance from shore (m)	Time of Day (AM or PM)	Transect Length (Km)	Number of Common Murres Observed	Density of Common Murres per Km²	Number of Marbled Murrelets Observed	Density of Marbled Murrelets per Km²
17 February 1999	Seal/Sail Rock to Pillar Point	200	AM	15.68	0	0.00	1	0.32
17 February 1999	Seal/Sail Rock to Pillar Point	200	PM	16.81	4	1.19	0	0.00
17 February 1999	Seal/Sail Rock to Pillar Point	500	AM	14.46	0	0.00	0	0.00
17 February 1999	Seal/Sail Rock to Pillar Point	800	PM	13.97	8	2.86	0	0.00
17 February 1999	Seal/Sail Rock to Pillar Point	Zig-Zag	PM	24.66	15	3.02	4	0.80
19 February 1999	Seal/Sail Rock to Pillar Point	200	PM	18.28	0	0.00	3	0.82
19 February 1999	Seal/Sail Rock to Pillar Point	500	AM	14.59	1	0.34	3	1.03
19 February 1999	Seal/Sail Rock to Pillar Point	800	AM	13.82	43	15.56	1	0.36
19 February 1999	Seal/Sail Rock to Pillar Point	1200	AM	13.53	14	5.17	1	0.37
19 February 1999	Seal/Sail Rock to Pillar Point	Zig-Zag	AM	24.11	24	4.98	8	1.66
19 February 1999	Seal/Sail Rock to Pillar Point	800	PM	13.90	11	3.96	0	0.00
19 February 1999	Seal/Sail Rock to Pillar Point	1200	PM	13.27	43	16.20	1	0.38
19 February 1999	Seal/Sail Rock to Pillar Point	Zig-Zag	PM	24.62	33	6.70	1	0.20
04 March 1999	Seal/Sail Rock to Pillar Point	200	AM	15.42	0	0.00	4	1.30
04 March 1999	Seal/Sail Rock to Pillar Point	500	AM	14.47	56	19.35	1	0.35
04 March 1999	Seal/Sail Rock to Pillar Point	Zig-Zag	AM	26.19	28	5.35	6	1.15
04 March 1999	Seal/Sail Rock to Pillar Point	200	PM	16.78	0	0.00	5	1.49
04 March 1999	Seal/Sail Rock to Pillar Point	1200	AM	16.74	12	3.58	0	0.00
04 March 1999	Seal/Sail Rock to Pillar Point	500	PM	7.21	0	0.00	1	0.69
05 March 1999	Seal/Sail Rock to Pillar Point	1200	AM	13.26	20	7.54	0	0.00
05 March 1999	Seal/Sail Rock to Pillar Point	200	PM	21.24	0	0.00	12	2.82
05 March 1999	Seal/Sail Rock to Pillar Point	200	AM	15.26	1	0.33	14	4.59
05 March 1999	Seal/Sail Rock to Pillar Point	500	PM	23.97	49	10.22	2	0.42
05 March 1999	Seal/Sail Rock to Pillar Point	500	PM	15.19	6	1.08	1	0.33
05 March 1999	Seal/Sail Rock to Pillar Point	800	AM	14.43	33	11.43	1	0.35
05 March 1999	Seal/Sail Rock to Pillar Point	800	PM	22.60	29	6.42	0	0.00
05 March 1999	Seal/Sail Rock to Pillar Point	Zig-Zag	AM	23.87	63	13.20	7	1.47
10 March 1999	Seal/Sail Rock to Pillar Point	1200	AM	13.00	44	16.92	1	0.38
10 March 1999	Seal/Sail Rock to Pillar Point	200	AM	14.72	0	0.00	2	0.68
10 March 1999	Seal/Sail Rock to Pillar Point	500	AM	15.29	0	0.00	1	0.33
10 March 1999	Seal/Sail Rock to Pillar Point	800	AM	13.65	15	5.49	0	0.00
10 March 1999	Seal/Sail Rock to Pillar Point	Zig-Zag	AM	25.13	14	2.79	0	0.00
10 March 1999	Seal/Sail Rock to Pillar Point	200	PM	22.36	0	0.00	2	0.45
10 March 1999	Seal/Sail Rock to Pillar Point	500	PM	20.66	1	0.24	0	0.00
10 March 1999	Seal/Sail Rock to Pillar Point	Zig-Zag	PM	31.18	35	5.61	5	0.80
11 March 1999	Seal/Sail Rock to Pillar Point	1200	AM	13.32	69	25.90	2	0.75
11 March 1999	Seal/Sail Rock to Pillar Point	200	AM	15.89	0	0.00	0	0.00
11 March 1999	Seal/Sail Rock to Pillar Point	800	AM	13.99	58	20.73	0	0.00
17 March 1999	Seal/Sail Rock to Pillar Point	200	AM	14.95	0	0.00	0	0.00
17 March 1999	Seal/Sail Rock to Pillar Point	500	AM	14.64	3	1.02	0	0.00
17 March 1999	Seal/Sail Rock to Pillar Point	800	AM	14.00	1	0.36	1	0.36
17 March 1999	Seal/Sail Rock to Pillar Point	1200	PM	13.23	5	1.89	0	0.00
18 March 1999	Seal/Sail Rock to Pillar Point	1200	AM	13.19	13	4.93	0	0.00
18 March 1999	Seal/Sail Rock to Pillar Point	500	AM	14.40	0	0.00	0	0.00
18 March 1999	Seal/Sail Rock to Pillar Point	800	AM	13.99	2	0.71	0	0.00

10 March 1999	Seal/Sail Rock to Pillar Point	Zig-Zag	AM	23.26	67	14.40	2	0.43

Total kilometers surveyed: 789.37

Table 6. Dates, locations and lengths of transects used in statistical power analyses of Marbled Murrelet density in relation to location, year, season, time of day and distance to shore.

Survey Date	Location of transect	Strait of Juan de Fuca or outer coast	Tran-sect length (km)	Number of Common Murres	Common Murre Density per km²	Number of Marbled Murrelets	Common Murre Density per km²
01 August 1995	Neah Bay to Pillar Point, 200 M, AM	S	49.08	0	0.00	23	2.34
01 August 1995	Neah Bay to Pillar Point, 400 M, PM	S	42.21	0	0.00	14	1.66
01 August 1995	Neah Bay to Pillar Point, 800 M, AM	S	41.64	0	0.00	4	0.48
01 August 1995	Neah Bay to Pillar Point, 1200 M, AM	S	42.18	0	0.00	1	0.12
02 August 1995	Neah Bay to Pillar Point, 200 M, AM (Partial)	S	16.43	0	0.00	12	3.65
02 August 1995	Neah Bay to Pillar Point, 800 M, PM	S	43.08	0	0.00	6	0.70
08 August 1995	Neah Bay to Pillar Point, 200 M, PM (Partial)	S	29.20	0	0.00	1	0.17
09 August 1995	Neah Bay to Sekiu, 200 M, AM	S	35.35	0	0.00	40	5.66
09 August 1995	Neah Bay to Sekiu, 400 M, PM	S	34.21	0	0.00	40	5.85
09 August 1995	Neah Bay to Sekiu, 800 M, PM	S	30.99	0	0.00	5	0.81
09 August 1995	Neah Bay to Sekiu, 1200 M, AM	S	28.77	0	0.00	0	0.00
10 August 1995	Neah Bay to Sekiu, 200 M, AM	S	32.94	0	0.00	17	2.58
10 August 1995	Neah Bay to Sekiu, 200 M, PM	S	34.64	0	0.00	27	3.90
10 August 1995	Neah Bay to Sekiu, 400 M, AM	S	31.54	0	0.00	19	3.01
10 August 1995	Neah Bay to Sekiu, 800 M, PM	S	29.40	0	0.00	0	0.00
10 August 1995	Neah Bay to Sekiu, 1200 M, PM	S	29.34	0	0.00	0	0.00
11 August 1995	Neah Bay to Sekiu, 400 M, AM (length?)	S	56.29	0	0.00	28	2.49
11 August 1995	Neah Bay to Sekiu, 800 M, AM (Partial)	S	17.72	0	0.00	7	1.98
20 August 1995	Tatoosh Island to Cape Alava, 400 M, PM	OC	26.24	0	0.00	11	2.10
21 August 1995	Tatoosh Island to Cape Alava, 400 M, PM	OC	26.05	0	0.00	12	2.30
22 August 1995	Tatoosh Island to Cape Alava, 400 M, AM	OC	26.73	0	0.00	20	3.74
22 August 1995	Tatoosh Island to Cape Alava, 1200 M, PM	OC	25.89	0	0.00	0	0.00
23 August 1995	Tatoosh Island to Cape Alava, 400 M, AM	OC	26.90	0	0.00	19	3.53
23 August 1995	Tatoosh Island to Cape Alava, 1200 M, AM	OC	26.05	0	0.00	0	0.00
23 August 1995	Tatoosh Island to Cape Alava, 1200 M, PM	OC	25.88	0	0.00	0	0.00
24 August 1995	Tatoosh Island to Cape Alava, 1200 M, AM	OC	28.79	0	0.00	0	0.00
12 Mar 1996	Sekiu to Neah Bay	S	31.51	0	0.00	7	0.98
12 Mar 1996	Sekiu to Neah Bay	S	29.03	40	17.27	5	1.80
12 Mar 1996	Sekiu to Neah Bay	S	27.00	21	6.67	7	2.22
12 Mar 1996	Sekiu to Neah Bay	S	28.08	85	28.07	0	0.00
13 Mar 1996	Sekiu to Neah Bay	S	32.40	4	1.36	33	11.19
13 Mar 1996	Sekiu to Neah Bay	S	31.55	0	0.00	21	4.37
13 Mar 1996	Sekiu to Neah Bay	S	26.48	7	2.17	16	4.95
13 Mar 1996	Sekiu to Neah Bay	S	27.54	11	3.53	1	0.32
14 Mar 1996	Sekiu to Neah Bay	S	31.69	0	0.00	40	8.72
14 Mar 1996	Sekiu to Neah Bay	S	29.42	0	0.00	11	3.35
14 Mar 1996	Sekiu to Neah Bay	S	26.40	117	36.79	0	0.00
14 Mar 1996	Sekiu to Neah Bay	S	26.32	16	4.96	5	1.55
23 May 1996	Sekiu to Neah Bay	S	13.95	19	6.74	3	1.06
23 May 1996	Sekiu to Neah Bay	S	14.08	23	26.20	9	10.25
23 May 1996	Sekiu to Neah Bay	S	14.29	6	2.39	5	1.99

23 May 1996	Sekiu to Neah Bay	S	14.26	9	3.10	7	2.41
23 May 1996	Sekiu to Neah Bay	S	15.07	40	8.45	3	0.63
23 May 1996	Sekiu to Neah Bay	S	14.98	9	4.76	2	1.06
23 May 1996	Sekiu to Neah Bay	S	18.14	46	15.60	21	7.12
23 May 1996	Sekiu to Neah Bay	S	18.32	8	2.90	5	1.81
24 July 1996	Seal/Sail Rock to Kydaka Point	S	13.79	8	2.85	2	0.71
24 July 1996	Seal/Sail Rock to Kydaka Point	S	14.24	18	6.47	0	0.00
24 July 1996	Seal/Sail Rock to Kydaka Point	S	15.03	12	4.29	0	0.00
24 July 1996	Seal/Sail Rock to Kydaka Point	S	17.67	17	6.23	1	0.37
24 July 1996	Seal/Sail Rock to Kydaka Point	S	17.89	14	5.50	0	0.00
25 July 1996	Seal/Sail Rock to Kydaka Point	S	11.59	62	25.16	18	7.31
25 July 1996	Seal/Sail Rock to Kydaka Point	S	14.24	30	11.48	4	1.53
25 July 1996	Seal/Sail Rock to Kydaka Point	S	14.32	12	4.47	1	0.37
25 July 1996	Seal/Sail Rock to Kydaka Point	S	15.00	16	5.35	0	0.00
25 July 1996	Seal/Sail Rock to Kydaka Point	S	16.00	16	6.27	7	2.44
25 July 1996	Seal/Sail Rock to Kydaka Point	S	17.88	33	10.08	3	0.92
26 July 1996	Seal/Sail Rock to Kydaka Point	S	13.20	16	7.35	13	5.97
13 February 1997	Neah Bay to Slip Point	S	31.40	0	0.00	44	17.52
13 February 1997	Neah Bay to Slip Point	S	30.10	0	0.00	9	3.47
13 February 1997	Neah Bay to Slip Point	S	29.69	0	0.00	1	0.24
13 February 1997	Neah Bay to Slip Point	S	27.30	0	0.00	2	0.80
11 June 1997	Fuca Pillar to Point of Arches	OC	10.42	39	18.71	2	0.53
11 June 1997	Fuca Pillar to Point of Arches	OC	17.28	140	40.51	5	0.62
12 June 1997	Fuca Pillar to Point of Arches	OC	16.98	53	15.61	8	2.56
12 June 1997	Fuca Pillar to Point of Arches	OC	16.73	73	21.82	10	2.29
12 June 1997	Fuca Pillar to Point of Arches	OC	12.52	107	42.73	3	0.35
12 June 1997	Fuca Pillar to Point of Arches	OC	12.27	78	31.78	3	0.47
12 June 1997	Fuca Pillar to Point of Arches	OC	16.06	81	25.22	6	1.19
12 June 1997	Fuca Pillar to Point of Arches	OC	13.91	38	13.66	0	0.00
12 June 1997	Fuca Pillar to Point of Arches	OC	15.74	37	11.75	7	2.98
12 June 1997	Fuca Pillar to Point of Arches	OC	16.41	119	36.26	0	0.00
24 June 1997	Fuca Pillar to Point of Arches	OC	16.53	102	30.85	6	0.97
24 June 1997	Fuca Pillar to Point of Arches	OC	17.08	72	21.08	17	4.03
24 June 1997	Fuca Pillar to Point of Arches	OC	12.46	44	17.66	2	0.57
24 June 1997	Fuca Pillar to Point of Arches	OC	12.81	129	50.35	3	0.30
24 June 1997	Fuca Pillar to Point of Arches	OC	14.57	138	47.36	0	0.00
24 June 1997	Fuca Pillar to Point of Arches	OC	16.10	109	33.85	0	0.00
24 June 1997	Fuca Pillar to Point of Arches	OC	17.41	113	32.45	2	0.31
24 June 1997	Fuca Pillar to Point of Arches	OC	19.21	144	37.48	2	0.27
25 June 1997	Fuca Pillar to Point of Arches	OC	16.31	111	34.03	1	0.15
25 June 1997	Fuca Pillar to Point of Arches	OC	12.64	29	11.47	1	0.44
25 June 1997	Fuca Pillar to Point of Arches	OC	14.74	244	82.77	0	0.00
25 June 1997	Fuca Pillar to Point of Arches	OC	17.93	99	27.61	2	0.36
09 July 1997	Fuca Pillar to Point of Arches	OC	18.08	240	66.37	6	0.45
09 July 1997	Fuca Pillar to Point of Arches	OC	16.26	256	78.72	27	1.71
09 July 1997	Fuca Pillar to Point of Arches	OC	9.42	65	34.50	11	1.59
09 July 1997	Fuca Pillar to Point of Arches	OC	10.59	130	61.38	5	0.41

09 July 1997	Fuca Pillar to Point of Arches	OC	14.07	144	51.17	12	1.17
09 July 1997	Fuca Pillar to Point of Arches	OC	14.22	191	67.16	3	0.22
09 July 1997	Fuca Pillar to Point of Arches	OC	16.04	277	86.35	15	0.87
09 July 1997	Fuca Pillar to Point of Arches	OC	17.00	224	65.88	14	1.06
10 July 1997	Fuca Pillar to Point of Arches	OC	11.44	160	69.93	4	0.29
10 July 1997	Fuca Pillar to Point of Arches	OC	15.97	92	28.80	27	4.69
10 July 1997	Fuca Pillar to Point of Arches	OC	13.03	103	39.52	3	0.38
10 July 1997	Fuca Pillar to Point of Arches	OC	14.04	171	60.90	6	0.49
10 July 1997	Fuca Pillar to Point of Arches	OC	13.97	93	33.29	12	1.80
10 July 1997	Fuca Pillar to Point of Arches	OC	16.82	160	47.56	17	1.79
22 July 1997	Seal Rock to Kydaka Point	S	14.48	1	0.35	30	434.40
22 July 1997	Seal Rock to Kydaka Point	S	14.40	11	3.82	8	10.47
22 July 1997	Seal Rock to Kydaka Point	S	14.14	27	9.55	9	4.71
22 July 1997	Seal Rock to Kydaka Point	S	14.74	9	3.05	1	1.64
22 July 1997	Seal Rock to Kydaka Point	S	14.39	31	10.77	3	1.39
22 July 1997	Seal Rock to Kydaka Point	S	14.28	34	11.90	1	0.42
22 July 1997	Seal Rock to Kydaka Point	S	17.30	52	15.03	0	0.00
22 July 1997	Seal Rock to Kydaka Point	S	16.72	52	15.55	12	3.86
23 July 1997	Seal Rock to Kydaka Point	S	14.68	324	110.35	9	0.41
23 July 1997	Seal Rock to Kydaka Point	S	14.10	69	24.47	1	0.20
23 July 1997	Seal Rock to Kydaka Point	S	14.10	256	90.78	2	0.11
23 July 1997	Seal Rock to Kydaka Point	S	21.03	131	31.15	2	0.32
24 July 1997	Seal Rock to Kydaka Point	S	15.04	41	13.63	19	0.97
24 July 1997	Seal Rock to Kydaka Point	S	15.03	14	4.66	23	24.69
24 July 1997	Seal Rock to Kydaka Point	S	14.28	159	55.67	5	0.45
24 July 1997	Seal Rock to Kydaka Point	S	14.33	51	17.79	4	1.12
24 July 1997	Seal Rock to Kydaka Point	S	13.93	42	15.08	0	0.00
24 July 1997	Seal Rock to Kydaka Point	S	14.00	29	10.36	0	0.00
24 July 1997	Seal Rock to Kydaka Point	S	19.68	208	52.85	16	1.51
24 July 1997	Seal Rock to Kydaka Point	S	20.78	183	44.03	8	0.01
25 July 1997	Seal Rock to Kydaka Point	S	14.05	115	40.93	2	0.24
19 Aug 1997	Seal Rock to Kydaka Point	S	14.63	40	13.67	13	4.75
19 Aug 1997	Seal Rock to Kydaka Point	S	15.52	17	5.48	1	0.91
19 Aug 1997	Seal Rock to Kydaka Point	S	14.67	40	13.63	1	0.37
19 Aug 1997	Seal Rock to Kydaka Point	S	18.98	58	15.28	2	0.65
20 Aug 1997	Seal Rock to Kydaka Point	S	14.99	31	10.34	1	0.48
20 Aug 1997	Seal Rock to Kydaka Point	S	20.69	67	16.19	4	1.24
25 Aug 1997	Seal Rock to Kydaka Point	S	14.99	55	18.35	6	1.64
25 Aug 1997	Seal Rock to Kydaka Point	S	14.87	26	8.74	3	1.72
25 Aug 1997	Seal Rock to Kydaka Point	S	14.17	10	3.53	0	0.00
25 Aug 1997	Seal Rock to Kydaka Point	S	13.73	25	9.10	0	0.00
25 Aug 1997	Seal Rock to Kydaka Point	S	13.89	19	6.84	0	0.00
25 Aug 1997	Seal Rock to Kydaka Point	S	20.60	25	6.07	3	2.47
22 January 1998	Seal/Sail Rock to Kydaka Point, 200 M, AM	S	15.52	1	0.32	10	3.22
22 January 1998	Seal/Sail Rock to Kydaka Point, 500 M, AM	S	15.11	10	3.31	10	3.31
27 January 1998	Seal/Sail Rock to Kydaka Point, 200 M, AM	S	15.98	1	0.31	5	1.56
27 January 1998	Seal/Sail Rock to Kydaka Point, 500 M, PM	S	13.98	29	10.37	10	3.58

27 January 1998	Seal/Sail Rock to Kydaka Point, 800 M, AM	S	14.07	20	7.11	1	0.36
27 January 1998	Seal/Sail Rock to Kydaka Point, Zig-Zag, AM	S	20.62	24	5.82	10	2.42
29 January 1998	Seal/Sail Rock to Kydaka Point, 200 M, AM	S	15.22	1	0.33	32	10.51
29 January 1998	Seal/Sail Rock to Kydaka Point, 200 M, PM	S	15.42	2	0.65	33	10.70
29 January 1998	Seal/Sail Rock to Kydaka Point, 500 M, AM	S	14.62	5	1.71	19	6.50
29 January 1998	Seal/Sail Rock to Kydaka Point, 500 M, PM	S	14.54	8	2.75	48	16.51
29 January 1998	Seal/Sail Rock to Kydaka Point, 800 M, AM	S	14.08	19	6.75	7	2.49
29 January 1998	Seal/Sail Rock to Kydaka Point 800 M, PM	S	13.98	24	8.58	1	0.36
29 January 1998	Seal/Sail Rock to Kydaka Point, Zig-Zag, AM	S	21.33	9	2.11	26	6.09
29 January 1998	Seal/Sail Rock to Kydaka Point, Zig-Zag, PM	S	21.81	58	13.30	28	6.42
04 February 1998	Seal/Sail Rock to Kydaka Point, 200 M, PM	S	15.65	0	0.00	5	1.60
04 February 1998	Seal/Sail Rock to Kydaka Point, Zig-Zag, PM	S	21.13	1	0.24	11	2.60
05 February 1998	Seal/Sail Rock to Kydaka Point, 200 M, PM	S	15.75	0	0.00	8	2.54
05 February 1998	Seal/Sail Rock to Kydaka Point, 500 M, AM	S	15.13	0	0.00	10	3.30
05 February 1998	Seal/Sail Rock to Kydaka Point, 500 M, PM	S	15.14	0	0.00	21	6.94
05 February 1998	Seal/Sail Rock to Kydaka Point, 800 M, AM	S	13.90	10	3.60	0	0.00
05 February 1998	Seal/Sail Rock to Kydaka Point, 800 M, PM	S	14.74	1	0.34	2	0.68
05 February 1998	Seal/Sail Rock to Kydaka Point, Zig-Zag, AM	S	35.80	6	0.84	4	0.56
05 February 1998	Seal/Sail Rock to Kydaka Point, Zig-Zag, PM	S	24.03	0	0.00	11	2.29
11 February 1998	Seal/Sail Rock to Kydaka Point, 200 M, PM	S	15.90	1	0.31	0	0.00
11 February 1998	Seal/Sail Rock to Kydaka Point, 200 M, PM	S	16.41	3	0.91	3	0.91
11 February 1998	Seal/Sail Rock to Kydaka Point, 500 M, AM	S	16.15	1	0.31	20	6.19
11 February 1998	Seal/Sail Rock to Kydaka Point, 500 M, PM	S	16.12	4	1.24	25	7.75
11 February 1998	Seal/Sail Rock to Kydaka Point, 800 M, AM	S	15.57	6	1.93	17	5.46
11 February 1998	Seal/Sail Rock to Kydaka Point, 800 M, PM	S	14.74	1	0.34	2	0.68
11 February 1998	Seal/Sail Rock to Kydaka Point, Zig Zag, AM	S	22.93	14	3.05	26	5.67
11 February 1998	Seal/Sail Rock to Kydaka Point, Zig-Zag, PM	S	23.66	28	5.92	25	5.28
17 February 1998	Fuca Pillar to Point of Arches (Partial), 700 M, AM	OC	9.45	152	80.42	9	4.76
17 February 1998	Fuca Pillar to Point of Arches, 700 M, AM	OC	12.55	32	12.75	7	2.79
17 February 1998	Fuca Pillar to Point of Arches, 1000 M, AM	OC	14.10	76	26.95	12	4.26
18 February 1998	Kydaka Point to Waadah Island, 1000 M, PM	OC	4.39	1	1.14	2	2.28
24 February 1998	Fuca Pillar to Point of Arches, 200 M, AM	OC	12.72	0	0.00	10	3.93
24 February 1998	Fuca Pillar to Point of Arches, 700 M, AM	OC	13.90	0	0.00	23	8.27
24 February 1998	Fuca Pillar to Point of Arches, 700 M, AM	OC	13.07	1	0.38	23	8.80
24 February 1998	Fuca Pillar to Point of Arches, 700 M, PM	OC	13.42	2	0.75	11	4.10
24 February 1998	Fuca Pillar to Point of Arches, 700 M, PM	OC	12.32	10	4.06	16	6.49
24 February 1998	Fuca Pillar to Point of Arches, 1000 M, AM	OC	13.78	0	0.00	14	5.08
24 February 1998	Fuca Pillar to Point of Arches, 1000 M, AM	OC	14.50	0	0.00	13	4.48
24 February 1998	Fuca Pillar to Point of Arches, 1000 M, PM	OC	14.04	1	0.36	27	9.62
24 February 1998	Fuca Pillar to Point of Arches, 1000 M, PM	OC	14.00	6	2.14	14	5.00
24 February 1998	Fuca Pillar to Point of Arches, 1000 M, PM	OC	13.65	0	0.00	17	6.23
25 February 1998	Fuca Pillar to Point of Arches, 700 M, AM	OC	10.88	4	1.84	15	6.89
25 February 1998	Fuca Pillar to Point of Arches, 700 M, PM	OC	12.56	0	0.00	19	7.56
25 February 1998	Fuca Pillar to Point of Arches, 700 M, PM	OC	12.98	2	0.77	17	6.55
25 February 1998	Fuca Pillar to Point of Arches, 1000 M, AM	OC	14.36	3	1.04	15	5.22
25 February 1998	Fuca Pillar to Point of Arches, 1000 M, PM	OC	14.96	2	0.67	14	4.68
25 February 1998	Fuca Pillar to Point of Arches, 1000 M, PM	OC	16.37	10	3.05	6	1.83

02 June 1998	Neah Bay to Kydaka Point, 500 M, AM	S	21.20	9	2.12	26	6.13
03 June 1998	Point of Arches to Skagway Rocks, 500 M, AM	OC	16.49	36	10.92	6	1.82
03 June 1998	Point of Arches to Skagway Rocks, 700 M, PM	OC	12.52	97	38.74	2	0.80
04 June 1998	Neah Bay to Kydaka Point, 500 M, PM	S	19.70	7	1.78	32	8.12
04 June 1998	Kydaka Point to Neah Bay, 500 M, PM	S	19.91	12	3.01	27	6.78
04 June 1998	Kydaka Point to Neah Bay, 1200 M, AM	S	19.88	16	4.02	22	5.53
04 June 1998	Neah Bay to Kydaka Point, 1200 M, PM	S	21.07	16	3.80	17	4.03
16 June 1998	Seal/Sail Rock to Kydaka PT., 200 M, AM	S	15.15	0	0.00	129	42.57
16 June 1998	Seal/Sail Rock to Kydaka PT., 200 M, PM	S	15.72	1	0.32	93	29.58
16 June 1998	Seal/Sail Rock to Kydaka PT., 500 M, AM	S	14.43	4	1.39	8	2.77
16 June 1998	Seal/Sail Rock to Kydaka PT., 500 M, AM	S	14.41	10	3.47	41	14.23
16 June 1998	Seal/Sail Rock to Kydaka PT., 800 M, AM	S	13.81	9	3.26	0	0.00
16 June 1998	Seal/Sail Rock to Kydaka PT., 800 M, PM	S	8.75	54	30.86	0	0.00
16 June 1998	Seal/Sail Rock to Kydaka PT., Zig-Zag, AM	S	21.34	16	3.75	74	17.34
17 June 1998	Seal/Sail Rock to Kydaka PT., 200 M, AM	S	15.01	3	1.00	126	41.97
17 June 1998	Seal/Sail Rock to Kydaka PT., 200 M, PM	S	15.06	4	1.33	125	41.50
17 June 1998	Seal/Sail Rock to Kydaka PT., 500 M, AM	S	14.43	1	0.35	56	19.40
17 June 1998	Seal/Sail Rock to Kydaka PT., 500 M, PM	S	14.50	12	4.14	15	5.17
17 June 1998	Seal/Sail Rock to Kydaka PT., 800 M, AM	S	13.99	19	6.79	11	3.93
17 June 1998	Seal/Sail Rock to Kydaka PT., 800 M, AM	S	13.98	9	3.22	4	1.43
17 June 1998	Seal/Sail Rock to Kydaka PT., Zig-Zag, AM	S	20.89	20	4.79	70	16.75
17 June 1998	Seal/Sail Rock to Kydaka PT., Zig-Zag, PM	S	20.36	14	3.44	50	12.28
18 June 1998	Seal/Sail Rock to Kydaka PT., 200 M, AM	S	15.25	3	0.98	239	78.36
18 June 1998	Seal/Sail Rock to Kydaka PT., 200 M, PM	S	15.11	4	1.32	195	64.53
18 June 1998	Seal/Sail Rock to Kydaka PT., 200 M, PM	S	13.77	35	12.71	6	2.18
18 June 1998	Seal/Sail Rock to Kydaka PT., 500 M, AM	S	14.33	7	2.44	32	11.17
18 June 1998	Seal/Sail Rock to Kydaka PT., 500 M, PM	S	14.64	6	2.05	7	2.39
18 June 1998	Seal/Sail Rock to Kydaka PT., Zig-Zag, AM	S	21.49	17	3.96	40	9.31
18 June 1998	Seal/Sail Rock to Kydaka PT., Zig-Zag, PM	S	21.28	24	5.64	36	8.46
07 July 1998	Outer Coast, Neah Bay south, 400M, AM	OC	17.61	310	88.02	20	5.68
07 July 1998	Outer Coast, Neah Bay south, 400M, AM	OC	17.14	126	36.76	11	3.21
07 July 1998	Outer Coast, Neah Bay south, 700M, AM	OC	12.44	89	35.77	3	1.21
07 July 1998	Outer Coast, Neah Bay south, 700M, PM	OC	12.61	212	84.06	0	0.00
07 July 1998	Outer Coast, Neah Bay south, 1000M, AM	OC	14.35	96	33.45	2	0.70
07 July 1998	Outer Coast, Neah Bay south, 1000M, PM	OC	14.22	146	51.34	0	0.00
07 July 1998	Outer Coast, Neah Bay south, Zig-Zag, AM	OC	17.57	75	21.34	0	0.00
07 July 1998	Outer Coast, Neah Bay south, Zig-Zag, AM	OC	18.42	111	30.13	0	0.00
09 July 1998	Outer Coast, Neah Bay south, 400M, AM	OC	16.61	36	10.84	22	6.62
09 July 1998	Outer Coast, Neah Bay south, 700M, PM	OC	12.80	42	16.41	5	1.95
09 July 1998	Outer Coast, Neah Bay south, 1000M, PM	OC	13.67	38	13.00	0	0.00
09 July 1998	Outer Coast, Neah Bay south, Zig-Zag, AM	OC	18.43	41	11.12	4	1.09
18 July 1998	Seal/Sail Rock to Kydaka PT., 800 M, AM	S	14.30	5	1.75	2	0.70
21 July 1998	Seal/Sail Rock to Kydaka PT., 200 M, AM	S	14.63	26	8.89	54	18.46
21 July 1998	Seal/Sail Rock to Kydaka PT., 200 M, PM	S	15.56	112	35.99	32	10.28
21 July 1998	Seal/Sail Rock to Kydaka PT., 500 M, AM	S	13.89	91	32.76	13	4.68
21 July 1998	Seal/Sail Rock to Kydaka PT., 500 M, PM	S	14.48	31	10.70	19	6.56
21 July 1998	Seal/Sail Rock to Kydaka PT., 800 M, PM	S	14.57	57	19.56	3	1.03

21 July 1998	Seal/Sail Rock to Kydaka PT., 800 M, PM	S	14.18	112	39.49	2	0.71
21 July 1998	Seal/Sail Rock to Kydaka PT., Zig-Zag, AM	S	21.95	194	44.19	31	7.06
21 July 1998	Seal/Sail Rock to Kydaka PT., Zig-Zag, PM	S	22.57	186	41.21	27	5.98
22 July 1998	Seal/Sail Rock to Kydaka PT., 200 M, AM	S	15.57	22	7.06	43	13.81
22 July 1998	Seal/Sail Rock to Kydaka PT., 500 M, AM	S	14.23	94	33.03	5	1.76
22 July 1998	Seal/Sail Rock to Kydaka PT., 800 M, AM	S	13.27	181	68.20	4	1.51
22 July 1998	Seal/Sail Rock to Kydaka PT., Zig-Zag, AM	S	21.50	395	91.86	24	5.58
23 July 1998	Outer Coast, Neah Bay south, 400M, AM	OC	16.40	49	14.94	6	1.83
23 July 1998	Outer Coast, Neah Bay south, 700M, AM	OC	12.67	31	12.33	3	1.19
23 July 1998	Outer Coast, Neah Bay south, 1000M, AM	OC	14.19	42	14.80	1	0.35
23 July 1998	Outer Coast, Neah Bay south, Zig-Zag, AM	OC	16.59	177	53.35	5	1.51
11 Aug 1998	Neah Bay to Kydaka Point, 500M, AM	S	19.63	4	1.02	10	2.55
13 Aug 1998	Neah Bay to Kydaka Point, 500M, AM	S	20.86	12	2.88	11	2.64
26 Aug 1998	Kydaka Point to Neah Bay, Zig-Zag, PM	S	25.47	25	4.91	0	0.00
27 Aug 1998	Fuca Pillar to Point of Arches, 400 M, AM	OC	18.84	22	5.84	3	0.80
27 Aug 1998	Point of Arches to Fuca Pillar, 1000 M, PM	OC	17.46	33	9.45	4	1.15
28 Aug 1998	Neah Bay to Kydaka Point, Zig-Zag, AM	S	25.41	31	6.10	3	0.59
01 Sept 1998	Fuca Pillar to Point of Arches, 400 M, PM	OC	46.21	49	5.30	0	0.00
01 Sept 1998	Neah Bay to Kydaka Point, Zig-Zag, AM	S	22.98	9	1.96	6	1.31
17 February 1999	Seal/Sail Rock to Kydaka Point	S	15.68	0	0.00	1	0.32
17 February 1999	Seal/Sail Rock to Kydaka Point	S	16.81	4	1.19	0	0.00
17 February 1999	Seal/Sail Rock to Kydaka Point	S	14.46	0	0.00	0	0.00
17 February 1999	Seal/Sail Rock to Kydaka Point	S	13.97	8	2.86	0	0.00
17 February 1999	Seal/Sail Rock to Kydaka Point	S	24.86	15	3.02	4	0.80
19 February 1999	Seal/Sail Rock to Kydaka Point	S	18.28	0	0.00	3	0.82
19 February 1999	Seal/Sail Rock to Kydaka Point	S	14.59	1	0.34	3	1.03
19 February 1999	Seal/Sail Rock to Kydaka Point	S	13.82	43	15.56	1	0.36
19 February 1999	Seal/Sail Rock to Kydaka Point	S	13.53	14	5.17	1	0.37
19 February 1999	Seal/Sail Rock to Kydaka Point	S	24.11	24	4.98	8	1.66
19 February 1999	Seal/Sail Rock to Kydaka Point	S	13.90	11	3.96	0	0.00
19 February 1999	Seal/Sail Rock to Kydaka Point	S	13.27	43	16.20	1	0.38
19 February 1999	Seal/Sail Rock to Kydaka Point	S	24.62	33	6.70	1	0.20
04 March 1999	Seal/Sail Rock to Kydaka Point	S	15.42	0	0.00	4	1.30
04 March 1999	Seal/Sail Rock to Kydaka Point	S	14.47	56	19.35	1	0.35
04 March 1999	Seal/Sail Rock to Kydaka Point	S	20.19	28	5.35	6	1.15
04 March 1999	Seal/Sail Rock to Kydaka Point	S	16.78	0	0.00	5	1.49
04 March 1999	Seal/Sail Rock to Kydaka Point	S	16.74	12	3.58	0	0.00
04 March 1999	Seal/Sail Rock to Kydaka Point	S	7.21	0	0.00	1	0.69
05 March 1999	Seal/Sail Rock to Kydaka Point	S	13.26	20	7.54	0	0.00
05 March 1999	Seal/Sail Rock to Kydaka Point	S	21.24	0	0.00	12	2.82
05 March 1999	Seal/Sail Rock to Kydaka Point	S	15.25	1	0.33	14	4.59
05 March 1999	Seal/Sail Rock to Kydaka Point	S	23.97	49	10.22	2	0.42
05 March 1999	Seal/Sail Rock to Kydaka Point	S	15.19	6	1.98	1	0.33
05 March 1999	Seal/Sail Rock to Kydaka Point	S	14.43	33	11.43	1	0.35
05 March 1999	Seal/Sail Rock to Kydaka Point	S	22.60	29	6.42	0	0.00
05 March 1999	Seal/Sail Rock to Kydaka Point	S	23.87	63	13.20	7	1.47
10 March 1999	Seal/Sail Rock to Kydaka Point	S	13.00	44	16.92	1	0.38

10 March 1999	Seal/Sail Rock to Kydaka Point	S	14.72	0	0.00	2	0.68
10 March 1999	Seal/Sail Rock to Kydaka Point	S	15.29	0	0.00	1	0.33
10 March 1999	Seal/Sail Rock to Kydaka Point	S	13.65	15	5.49	0	0.00
10 March 1999	Seal/Sail Rock to Kydaka Point	S	25.13	14	2.79	0	0.00
10 March 1999	Seal/Sail Rock to Kydaka Point	S	22.36	0	0.00	2	0.45
10 March 1999	Seal/Sail Rock to Kydaka Point	S	20.66	1	0.24	0	0.00
10 March 1999	Seal/Sail Rock to Kydaka Point	S	31.18	35	5.61	5	0.80
11 March 1999	Seal/Sail Rock to Kydaka Point	S	13.32	69	25.90	2	0.75
11 March 1999	Seal/Sail Rock to Kydaka Point	S	15.80	0	0.00	0	0.00
11 March 1999	Seal/Sail Rock to Kydaka Point	S	13.99	58	20.73	0	0.00
17 March 1999	Seal/Sail Rock to Kydaka Point	S	14.95	0	0.00	0	0.00
17 March 1999	Seal/Sail Rock to Kydaka Point	S	14.64	3	1.02	0	0.00
17 March 1999	Seal/Sail Rock to Kydaka Point	S	14.00	1	0.36	1	0.36
17 March 1999	Seal/Sail Rock to Kydaka Point	S	13.23	5	1.89	0	0.00
18 March 1999	Seal/Sail Rock to Kydaka Point	S	13.19	13	4.93	0	0.00
18 March 1999	Seal/Sail Rock to Kydaka Point	S	14.40	0	0.00	0	0.00
18 March 1999	Seal/Sail Rock to Kydaka Point	S	13.99	2	0.71	0	0.00
18 March 1999	Seal/Sail Rock to Kydaka Point	S	23.26	67	14.40	2	0.43