DISTRIBUTION AND ABUNDANCE OF RINGED AND BEARDED SEALS IN WAGER BAY, NORTHWEST TERRITORIES

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N.W.T. WILDLIFE SERVICE

1981

File Report No. 12

This report has been submitted for publication in the Arctic Island Pipeline Project (AIPP) report series. The AIPP report format has been used rather than that of the N.W.T. Wildlife Service.

ABSTRACT

An aerial census of ringed seals (<u>Phoca hispida</u>) and bearded seals (<u>Erignathus barbatus</u>) in Wager Bay, Northwest Territories, was conducted on 20 June 1977. The bay was ice covered, with some overflow water on the ice. We flew in a Cessna 337 aircraft, 150 m above sea level at 230 km/hr. Transects were systematically spaced to provide 25% coverage. We observed 1.03 ringed seals per km^2 and 0.01 bearded seals per km^2, indicating that there were at least 2,500 $\pm$ 200 ringed seals and about 30 bearded seals hauled out on the ice. Ringed seals were aggregated rather than randomly dispersed and showed a slight preference for water depths of between 76 and 100 m.

ACKNOWLEDGEMENTS

We thank Brodie Broderick for assistance with the field work, Rae McNamara our pilot, and Dr. Ian Stirling and Jonquil Graves for reviewing the manuscript. Financial support was provided by the Environmental Social Program (Arctic Island Pipeline Project) and Parks Canada.

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1. INTRODUCTION

The proposed construction of an arctic gas pipeline in the vicinity of Wager Bay and the interest of Parks Canada in locating a National Park in the area prompted a need for information on wildlife in the Wager Bay area. Our seal census was one part of our inventory program designed to document the importance of Wager Bay for wildlife populations.

Observations by the senior author in the spring and summer of 1976 indicated that both ringed seals (*Phoca hispida*) and bearded seals (*Erignathus barbatus*) occurred in Wager Bay, and that ringed seals were quite abundant. The high frequency of polar bear (*Ursus maritimus*) observations in 1976 (Donaldson et al. 1980) also indicated that seals might be abundant in this area, because polar bear distribution and abundance is possibly related to the availability of seals (Stirling and Smith 1977). The objective of this survey was to estimate the numbers, density and distribution of seals in Wager Bay.

2. STUDY AREA

Wager Bay is an inland arctic sea about 150 km long and up to 36 km wide and is connected to Hudson Bay by a channel only 3.5 km wide (Fig. 1). In June of both 1976 and 1977, the sea ice had overflow water on it. There were no leads or open water areas within the bay, but both the east and west ends (Fig. 1) were kept open by tidal currents. Breakup in 1976 and 1977 occurred in early July, and the bay became completely ice free by August. Freeze-up occurred sometime after mid-September.

3. METHODS

3.1 Aerial Survey Design

Seals are most easily seen and counted when they are basking on the sea ice. The greatest percentage of the seal population is hauled out on the sea ice in the early afternoon during the molting period in late June (Stirling et al. 1977, Finley 1979). We planned our survey to coincide with this haul-out peak. The census was done on 20 June 1977 between 11:45 and 15:30 EST. The day was clear and calm.

To determine the general distribution of seals and to simplify flight details, transects were systematically spaced at 4 km intervals and oriented perpendicular to the long axis of Wager Bay (Fig. 1). Transects were flown at an altitude of 152 m and a speed of 230 km/hr in a Cessna 337 aircraft with two observers in the back seats. Seals were counted within a 500 m wide strip on each side. Neither observer was experienced in counting or identifying seals but both were familiar with aerial survey techniques. Transect strips were delineated using appropriately placed markers on the wing struts. Seal observations were partitioned into sample units of 1-minute intervals for detailed distributional analysis. The senior author navigated, subjectively assessed the amount of overflow water on the ice, and indicated the time intervals to the observers. The percentage of ice area covered by melt water was estimated at 1-minute intervals as we thought that overflow water may influence seal distribution.

3.2 Data Analysis

Population estimate and variance were calculated using Jolly's Method 2 for unequal length transects (Jolly 1969). The rationale for using this method is described in Pennycuick et al. (1977). The sample units for distribution analysis were 1-minute time intervals. Partial units (i.e. those at the ends of transects) were omitted from distribution analysis. A paired two-tailed t-test comparing the mean number of ringed seals observed per transect was used to test for observer bias.

4. RESULTS AND DISCUSSION

4.1 Population Estimates and Density

The estimate of 2,584 ringed seals (Table 1) is undoubtedly an underestimate of the actual number inhabiting Wager Bay since not all seals would be hauled out on the ice during the survey. Finley (1979) suggested that the proportion of seals hauled out on the ice under ideal conditions is probably over 70% and may be over 80% of the total population. Our survey took place between 1100 and 1600 hours on a clear calm day in late June--ideal haul-out conditions as described by Finley (1979). Thus the ringed seal population of Wager Bay is probably over 3,200 (2,584/ 0.8 = 3,230; 2,584/0.7 = 3,691).

The density of ringed seals in Wager Bay (1.03/km^2) was higher than that observed in most other study areas of comparable size (Table 2). Aston Bay and Freeman's Cove (Finley 1979) are both much smaller than Wager Bay; their surface areas are only about 2% and 1%, respectively, that of Wager Bay. Small areas of Wager Bay also had high seal densities.

The relatively high density of ringed seal in Wager Bay may be due to the presence of suitable habitat. Ringed seals prefer areas with a high percentage of ice cover (Stirling et al. 1977) and stable ice conditions (Burns and Harbo 1972, Finley 1979). Both these features are characteristic of Wager Bay. Stirling and Smith (1977) suggested that high ringed seal density may contribute to a high polar bear density. This may be the case in Wager Bay where we observed a high density (85 bears/1000 km of shoreline) of polar bears (Donaldson et al. 1980).

The density of bearded seals (0.01 km^2) was lower than that of ringed seals but similar to densities observed in the Beaufort Sea (Table 2).

4.2 Distribution Among Sample Units

Ringed seals were not randomly distributed within Wager Bay (Table 3). Clumping was demonstrated by our observations of a greater than expected number of sample units both with few seals (0 to 2) and with many seals (>9). Stirling et al. (1977) also found that the distribution of ringed seals (and bearded seals) did not fit a Poisson model and that both species tended to be clumped. Seals are possibly clumped, not because of social tendencies, but in order to make use of relatively scarce haul-out areas. In open water during the summer, our subjective impression was that ringed seals tended to be solitary.

4.3 Dispersion in Relation to Depth

Wager Bay depth records are available only within a small strip extending from Douglas Harbour, east along the north shore and south of the Savage Islands, to Roes Welcome Sound (Canadian Hydrographic Service, Chart No. 5440, Wager Bay, Northwest Territories, Department of Environment, Ottawa 1974).

Depth readings were available for only 21 of the 159 sample units. When more than one reading occurred within a sample unit the mean reading was used in the analysis. The distribution of seals with respect to depth resembled a random distribution ($0.1 < p < 0.05$, Table 4) but there was a slight preference for depths between 76 and 100 m.

4.4 Dispersion in Relation to Overflow

There was a significant positive correlation between the estimated amount of overflow covering the ice (averaging 40%) and the number of seals counted per sampling unit ($r = 0.492$, $df = 92$, $p < 0.01$). Overflow percentage estimates were not transformed since most (61%) were between 30 and 70%. We cannot explain this relationship. Finley's data suggest that if any correlation exists between overflow and seal density, it should be negative because seal holes provide drainage for the surface melt water (Finley 1979).

4.5 Observer Bias

There was a significant difference in the number of seals counted by each observer ($t = 3.496$, $df = 25$, $p < 0.01$). This difference is probably due either to the strip widths varying between observers, or to observers' ability to distinguish seals from dark spots and holes in the ice. Observer fatigue was not a problem since there were frequent short breaks between transects and there were never long stretches devoid of seals. Since there is no way to determine which observer counted most accurately, the results were not altered.

5. CONCLUSIONS

The results of our aerial census of seals on 20 June 1977 indicated that there were at least 2,584 ringed seals and 28 bearded seals in Wager Bay. The density of ringed seals was higher than in most other locations studied and may be responsible for a relatively high density of polar bears observed in Wager Bay. This study confirms that Wager Bay is an important area for wildlife.

Table 1. Number of seals observed per transect in Wager Bay, 20 June 1977.

Transect		Ringed seals		Bearded seals
Number	Length(km) =area(km^2)	Number observed	(seals/ km^2)	Number observed
1	15.7	12	0.76	
2	19.3	36	1.87	2
3	21.5	36	1.67	
4	23.3	23	0.99	
5	29.4	33	1.12	
6	32.7	25	0.76	
7	36.2	27	0.75	
8	35.7	27	0.76	
9	32.9	19	0.58	
10	31.7	20	0.63	
11	33.5	22	0.66	
12	32.9	21	0.64	
13	28.6	23	0.80	
14	25.6	26	1.02	
15	25.3	13	0.51	
16	23.3	31	1.33	
17	23.1	26	1.13	
18	23.3	24	1.03	
19	22.0	55	2.50	
20	21.8	31	1.42	1
21	18.8	36	1.91	1
22	20.3	25	1.23	2
23	13.7	17	1.24	
24	15.0	12	0.80	1
25	12.2	6	0.49	
26	9.4	13	1.38	
27	3.0	7	2.33	
Totals	630.2	646	1.03	7
Population Estimates		2584		28
Variance		40066		117.6
Standard Error		200		10.8
95% Confidence Limits		± 15.9%		± 80.0%

Table 2. Densities of ringed and bearded seal in Wager Bay compared with other areas.

Area	Density ($seals/km^2$) Ringed seals	Bearded seals	Reference
Wager Bay	1.03	0.011	This study
North Alaska coast	0.72	-	Burns and Harbo (1972)
Beaufort Sea 1974	0.34	0.021	
Beaufort Sea 1975	0.21	0.015	Stirling et al. (1977)
Amundsen Gulf 1974	0.29	0.019	
Amundsen Gulf 1975	0.36	0.012	
Amundsen Gulf	1.91	-	Smith (1973a)
Amundsen Gulf	0.97	-	Ward (1979)
Bering Strait	0.25	-	Johnson et al. (1966)
Home Bay, North Baffin Island	1.02	-	Smith (1973b)
Freeman's Cove, Bathurst Island	4.86	-	Finley (1979)
Aston Bay, Somerset Island	10.44[1]	-	Finley (1979)

[1] High density resulting from an influx of seals abandoning unstable ice.

Table 3. Frequency distribution of ringed seals per sample unit compared to a Poisson distribution.

Class (No. seals/ sample unit)	Observed frequency		Frequency expected in a Poisson distribution	
0	7		2.67	
1	23		10.64	
2	18		21.17	
3	30		28.08	
4	16		27.94	
5	13		22.23	
6	14		14.74	
7	5		8.38	
8	2		4.17	
9	6		1.84	
10	3		0.73	
11	2	17	0.27	7.13
12	2		0.09	
13	2		0.03	
Total	143		142.98	

$X^2 = 45.97$ for d.f. = 8, $p < 0.01$

Table 4. The number of ringed seals vs. depth in Wager Bay and the expected frequency based on a random and a previously observed distribution.

Depth (m)	No. of sample units	No. of seals observed	No. of seals expected from a random distribution	No. of seals expected from Stirling et al. (1977)
0-25	4	10	18.9[1]	18.5
26-50	3	16	14.1	17.4
51-75	3	10	14.1	13.7
76-100	6	37	28.3	17.7
101-125	4 } 5	25 } 26	23.6	31.7
126-150	1	1		
Totals	21	99	99.0	98.9
			$X^2 = 8.558$ $0.1 < p < 0.05$	$X^2 = 27.041$ $p < 0.01$

[1] e.g. 4/21 x 99 = 18.9

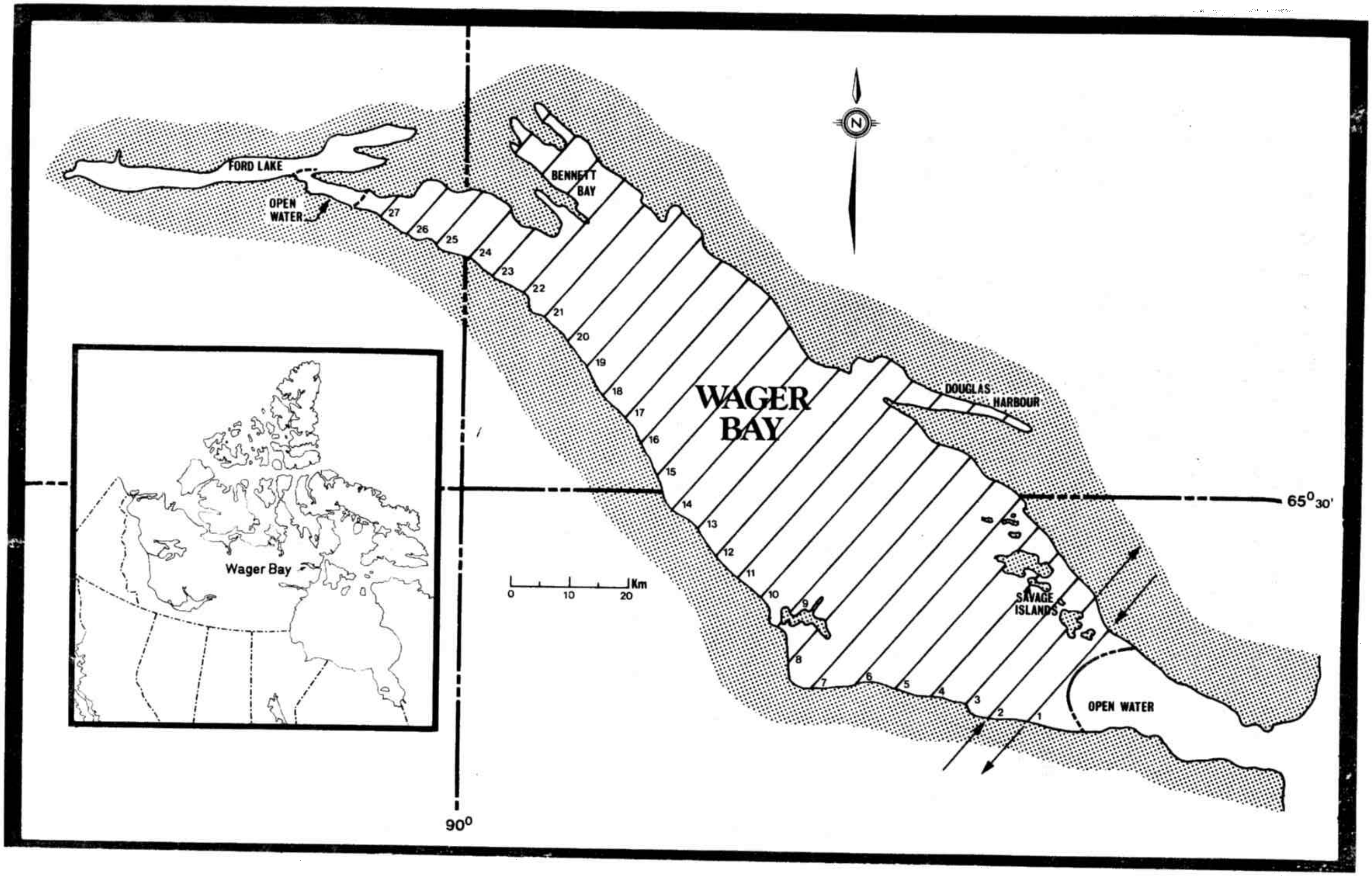

Figure 1. Map of the Wager Bay study area indicating the orientation of transect lines, 20 June 1977.

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APPENDIX

Number of ringed seals observed per sample unit

Transect number	Time interval (min.)	Left observer	Right observer	Total
1	0 - 1	1	0	1
	1 - 2	1	0	1
	2 - 3	1	0	1
	3 - 4	3	5	8
	4+	1	0	1
	Total (4:15)	7	5	12
2	0 - 1	5	1	6
	1 - 2	1	0	1
	2 - 3	10	3	13
	3 - 4	6	6	12
	4 - 5	1	0	1
	5+	1	2	3
	Total (5:55)	24	12	36
3	0 - 1	2	3	5
	1 - 2	2	0	2
	2 - 3	5	6	11
	3 - 4	2	4	6
	4 - 5	0	7	7
	5 - 6	0	5	5
	Total (6:00)	11	25	36
4	0 - 1	0	5	5
	1 - 2	1	1	2
	2 - 3	2	1	3
	3 - 4	1	1	2
	4 - 5	0	6	6
	5 - 6	0	0	0
	6+	5	0	5
	Total (6:55)	9	14	23

Transect number	Time interval (min.)	Left observer	Right observer	Total
5	0 - 1	0	4	4
	1 - 2	0	5	5
	2 - 3	2	1	3
	3 - 4	0	5	5
	4 - 5	2	2	4
	5 - 6	2	2	4
	6 - 7	4	3	7
	7+	0	1	1
	Total (7:10)	10	23	33
6	0 - 1	4	1	5
	1 - 2	2	0	2
	2 - 3	1	0	1
	3 - 4	0	3	3
	4 - 5	1	1	2
	5 - 6	0	1	1
	6 - 7	0	4	4
	7 - 8	0	4	4
	8+	0	3	3
	Total (8:30)	8	17	25
7	0 - 1	1	2	3
	1 - 2	0	5	5
	2 - 3	0	3	3
	3 - 4	0	2	2
	4 - 5	0	3	3
	5 - 6	0	1	1
	6 - 7	0	1	1
	7 - 8	0	6	6
	8 - 9	1	2	3
	Total (9:00)	2	25	27
8	0 - 1	2	0	2
	1 - 2	3	2	5
	2 - 3	1	0	1
	3 - 4	0	4	4
	4 - 5	0	1	1
	5 - 6	0	2	2
	6 - 7	0	2	2
	7 - 8	0	3	3
	8 - 9	1	2	3
	9+	0	1	1

Transect number	Time interval (min.)	Left observer	Right observer	Total
8 (cont'd)				
D.H.[1]	0+	0	3	3
	Total (9:40)	7	20	27
9	0 - 1	0	1	1
	1 - 2	1	3	4
	2 - 3	0	1	1
	3 - 4	0	4	4
	4 - 5	1	3	4
	5 - 6	2	1	3
	6 - 7	1	1	2
	7+	0	0	0
	Total (7:45)	5	14	19
10	0 - 1	1	0	1
	1 - 2	2	1	3
	2 - 3	1	5	6
	3 - 4	0	0	0
	4 - 5	1	2	3
	5 - 6	0	1	1
	6 - 7	0	4	4
	7 - 8	1	0	1
	8 - 9	0	1	1
	Total (9:00)	6	14	20
11	0 - 1	2	2	4
	1 - 2	1	5	6
	2 - 3	2	(data lost)	2
	3 - 4	1	(data lost)	1
	4 - 5	0	0	0
	5 - 6	0	1	1
	6 - 7	2	0	2
	7 - 8	1	4	5
	8+	0	1	1
	Total	9	13	22
12	0 - 1	0	0	0
	1 - 2	0	0	0
	2 - 3	0	1	1
	3 - 4	0	3	3
	4 - 5	1	1	2
	5 - 6	1	2	3

Transect number	Time interval (min.)	Left observer	Right observer	Total
12 (cont'd)	6 - 7	0	3	3
	7 - 8	2	7	9
	8+	0	0	0
	Total (8:35)	4	17	21
13	0 - 1	1	1	2
	1 - 2	0	3	3
	2 - 3	5	0	5
	3 - 4	0	1	1
	4 - 5	3	2	5
	5 - 6	0	3	3
	6 - 7	3	0	3
	7+	1	0	1
	Total (7:35)	13	10	23
14	0 - 1	2	1	3
	1 - 2	2	2	4
	2 - 3	2	1	3
	3 - 4	1	0	1
	4 - 5	2	4	6
	5 - 6	1	5	6
	6 - 7	2	1	3
	Total (7:00)	12	14	26
15	0 - 1	0	1	1
	1 - 2	1	4	5
	2 - 3	1	1	2
	3 - 4	1	1	2
	4 - 5	1	0	1
	5 - 6	2	0	2
	6+	0	0	0
	Total (6:45)	6	7	13
16	0 - 1	3	1	4
	1 - 2	1	2	3
	2 - 3	1	2	3
	3 - 4	4	6	10
	4 - 5	1	3	4
	5+	2	5	7
	Total (5:55)	12	19	31

Transect number	Time interval (min.)	Left observer	Right observer	Total
17	0 - 1	1	0	1
	1 - 2	1	2	3
	2 - 3	2	4	6
	3 - 4	1	3	4
	4 - 5	1	1	2
	5 - 6	6	4	10
	Total	12	14	26
18	0 - 1		1	
	1 - 2	8	3	12
	2 - 3	1	0	1
	3 - 4	4	2	6
	4 - 5	2	2	4
	5+	1	0	1
	Total (5:50)	16	8	24
19	0 - 1	3	6	9
	1 - 2	6	3	9
	2 - 3	5	2	7
	3 - 4	4	7	11
	4 - 5	7	6	13
	5+	0	6	6
	Total (5:45)	25	30	55
20	0 - 1	0	2	2
	1 - 2	4	5	9
	2 - 3	4	6	10
	3 - 4	0	6	6
	4 - 5	2	2	4
	5+	0	0	0
	Total	10	21	31
21	1 - 1	5	7	12
	1 - 2	3	5	8
	2 - 3	3	0	3
	3 - 4	1	6	7
	4+	1	5	6
	Total (4:50)	13	23	36

Transect number		Time interval (min.)	Left observer	Right observer	Total
22		0 - 1	3	2	5
		1 - 2	6	3	9
		2 - 3	3	0	3
		3 - 4	1	4	5
		4 - 5	1	2	3
		5+			
		Total	14	11	25
23		0 - 1	4	2	6
	B.B.[2]	1 - 2	0	0	0
		2+	0	0	0
		0 - 1	4	7	11
	W.B.[3]	1 - 2	0	0	0
		Total	8	9	17
24		0 - 1	4	2	6
	W.B.[3]	1 - 2	1	2	3
		0 - 1	0	3	3
	B.B.[2]	1+	0	0	0
		Total	5	7	12
25		0 - 1	0	1	1
	W.B.[3]	1+	0	0	0
		0 - 1		1	5
	B.B.[2]	1+	3	1	
		Total	3	3	6
26		0+	4	9	13
27		0+	1	6	7
F. L.[4]		0 - 1	0	1	1
		1 - 2	0	0	0
		2 - 3	0	2	2
		3 - 4	2	0	2
		4 - 5	2	0	2
		5 - 6	0	0	0
		6+	0	2	2
	Total	(6:30)	4	5	9

1 Douglas Harbour
2 Bennett Bay
3 Wager Bay
4 Ford Lake