

The feasibility of using stratified-random survey design for
measuring groundfish abundance in inshore bays

by
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INTRODUCTION

Over the past few years, obtaining estimates of fish biomass in the inshore areas and bays of Newfoundland has become increasingly important because of the high landings of inshore fishermen and the possibility of the inshore areas as nurseries for certain groundfish species such as greyscale. Difficulty in surveying bays has always been a problem mostly because of the abundance of fixed gear in the area interfering with research otter trawling operations. To use fixed gear for surveying was not very appealing because of its high selection properties and its great demand on time to cover any one area. In 1978 a project was designed to attempt a survey in an inshore bay using a small research otter trawler. The survey was designed by means of a new stratification system according to the methods used recently in offshore areas.

MATERIALS AND METHODS

Based upon previous investigations and with considerable knowledge of the general fishing pattern around the coast of Newfoundland in the inshore areas, it was concluded that Fortune Bay on the South Coast of

the province was the best possibility for success of such a survey. The bottom of the bay is suitable for dragging operations in most of the region and most of the commercial fishing operations here are by mobile gear, therefore, providing little problem to a small otter trawler.

THE STRATIFICATION DESIGN

The stratification design covered a depth range of 100-400 meters, since it was virtually impossible to fish safely inside the 100 meter contour. One small section in the inner portion of the bay was excluded from the design since it was known from previous experiments that the area could not be fished. A total of 9 strata were constructed (Fig. 1) covering an area of 468 square miles. Four strata were from 101-200 meters; three from 201-300 meters and two from 301-400 meters (Table 1). There were a total of 171 unit areas of 2.70-2.80 square miles each from which to randomly choose the fishing stations.

RESULTS AND DISCUSSION

A total of 32 successful fishing sets was conducted (Fig.2) covering 8 of 9 strata. Estimates of trawlable* biomass were obtained for the stratified area fished for the major commercial species in the area (Table 2, a-j).

The stratified random survey method appeared to be a reasonable success for this particular bay. The minimum trawlable biomass estimates are probably underestimated for some species such as cod and American plaice since a considerable

*biomass estimates by this technique are always minimal because of trawl catchability coefficient.

portion of the bay has a depth range less than 100 meters, however, trawlable biomass estimates of deepwater species such as witch, turbot and redfish are probably fairly realistic. Although this system worked well for Fortune Bay, it will probably not work for many other bays such as Notre Dame Bay, Trinity Bay and Bonavista Bay. The potential for its use in St. George's Bay, however, is quite plausible and will be tested in the near future.

Table 1.- Area, depth range and number of standard units for strata in Fortune Bay. Standard unit is 02' Latitude X 02' Longitude.

Strata	Area Square miles	Depth Range meters	No. units
101	65.0	100-200	24
102	80.9	201-300	29
103	33.3	301-400	12
104	51.5	101-200	19
105	49.0	201-300	18
106	25.4	101-200	9
107	18.3	301-400	7
108	92.0	201-300	33
109	53.0	101-200	20

Table 2a.

SHAMOOK 36 1978 FORTUNE BAY

TURBOT

STRATUM	NO. SETS	NUMBER	SET/AV.	UNITS	TOTAL NO	VAR.
101	3	0.0	0.0	7528.	0.	0.0
102	5	65.00	13.00	9381.	121951.	68.50
103	3	158.00	52.67	3822.	201284.	196.33
104	3	2.00	0.67	6022.	4015.	0.33
106	2	0.0	0.0	3011.	0.	0.0
107	5	235.00	47.00	2085.	97978.	3944.00
108	5	78.00	15.60	10655.	166215.	487.30
109	5	0.0	0.0	6138.	0.	0.0

MEAN	NUMBER UPPER	LOWER	MEAN	AVERAGE UPPER	LOWER
591443.	889448.	293439.	12.16	18.29	6.03

Table 2b.

SHAMOOK 36 1978 FORTUNE BAY

TURBOT

STRATUM	NO. SETS	WEIGHT	SET/AV.	UNITS	TOTAL WT	VAR.
101	3	0.0	0.0	7528.	0.	0.0
102	5	66.00	13.20	9381.	123828.	8.82
103	3	90.75	30.25	3822.	115611.	10.56
104	3	4.75	1.58	6022.	9535.	3.77
106	2	0.0	0.0	3011.	0.	0.0
107	5	133.15	26.63	2085.	55514.	843.65
108	5	60.38	12.08	10655.	128668.	265.96
109	5	0.0	0.0	6138.	0.	0.0

MEAN	WEIGHT UPPER	LOWER	MEAN	AVERAGE UPPER	LOWER
433155.	644286.	222024.	8.91	13.25	4.56

Table 2c.

SHAMOOK 36 1978 FORTUNE BAY

AM PLAICE

STRATUM	NO. SETS	NUMBER	SET/AV.	UNITS	TOTAL NO	VAR.	
101	3	287.00	95.67	7528.	720166.	15304.33	
102	5	59.00	11.80	9381.	110694.	291.20	
103	3	11.00	3.67	3822.	14013.	1.33	
104	3	95.00	31.67	6022.	190706.	552.33	
106	2	583.00	291.50	3011.	877749.	48984.50	
107	5	20.00	4.00	2085.	8339.	14.50	
108	5	158.00	31.60	10655.	336692.	227.30	
109	5	824.92	164.98	6138.	1012693.	226.82	
	MEAN	NUMBER UPPER		LOWER	MEAN	AVERAGE UPPER	LOWER
	3271050.	5585203.		956897.	67.25	114.82	19.67

Table 2d.

SHAMOOK 36 1978 FORTUNE BAY

AM PLAICE

STRATUM	NO. SETS	WEIGHT	SET/AV.	UNITS	TOTAL WT	VAR.	
101	3	77.50	25.83	7528.	194470.	654.02	
102	5	13.50	2.70	9381.	25328.	14.45	
103	3	3.50	1.17	3822.	4459.	0.52	
104	3	29.00	9.67	6022.	58215.	36.40	
106	2	196.93	98.46	3011.	296493.	3790.59	
107	5	9.71	1.94	2085.	4048.	4.45	
108	5	57.21	11.44	10655.	121913.	80.92	
109	5	371.83	74.37	6138.	456462.	1492.87	
	MEAN	WEIGHT UPPER		LOWER	MEAN	AVERAGE UPPER	LOWER
	1161387.	1714890.		607884.	23.88	35.26	12.50

Table 2e.

SHAMOOK 36 1978 FORTUNE BAY

GREYSOLE

STRATUM	NO. SETS	NUMBER	SET/AV.	UNITS	TOTAL NO	VAR.
101	3	0.0	0.0	7528.	0.	0.0
102	5	90.00	18.00	9381.	168856.	164.00
103	3	6.00	2.00	3822.	7644.	4.00
104	3	123.00	41.00	6022.	246914.	1900.00
106	2	12.00	6.00	3011.	18067.	2.00
107	5	106.00	21.20	2085.	44194.	594.70
108	5	130.00	26.00	10655.	277026.	423.50
109	5	37.85	7.57	6138.	46461.	152.66

MEAN	NUMBER UPPER	LOWER	MEAN	AVERAGE UPPER	LOWER
809161.	1317986.	300335.	16.64	27.10	6.17

Table 2f.

SHAMOOK 36 1978 FORTUNE BAY

GREYSOLE

STRATUM	NO. SETS	WEIGHT	SET/AV.	UNITS	TOTAL WT	VAR.
101	3	0.0	0.0	7528.	0.	0.0
102	5	70.75	14.15	9381.	132739.	122.61
103	3	6.25	2.08	3822.	7962.	5.15
104	3	101.50	33.83	6022.	203754.	1490.58
106	2	7.79	3.89	3011.	11728.	0.83
107	5	105.54	21.11	2085.	44003.	613.91
108	5	113.90	22.78	10655.	242717.	399.73
109	5	25.88	5.18	6138.	31776.	60.59

MEAN	WEIGHT UPPER	LOWER	MEAN	AVERAGE UPPER	LOWER
674680.	1126935.	222425.	13.87	23.17	4.57

Table 2g.

SHAMOOK 36 1978 FORTUNE BAY

REDFISH MENTELLA

STRATUM	NO. SETS	NUMBER	SET/AV.	UNITS	TOTAL NO	VAR.
101	3	2495.00	831.67	7528.	6260674.20	13173.00
102	5	822.00	164.40	9381.	1542216.	53666.30
103	3	19.00	6.33	3822.	24205.	60.33
104	3	308.00	102.67	6022.	618289.	27744.33
106	2	188.00	94.00	3011.	283048.	15842.00
107	5	15.00	3.00	2085.	6254.	5.00
108	5	13.00	2.60	10655.	27703.	5.80
109	5	122.00	24.40	6138.	149770.	1741.30
	MEAN	NUMBER			MEAN	AVERAGE
		UPPER	LOWER		UPPER	LOWER
	8912153.	35204992.	-17380688.		183.22	723.76
						-357.32

Table 2h.

SHAMOOK 36 1978 FORTUNE BAY

REDFISH MENTELLA

STRATUM	NO. SETS	WEIGHT	SET/AV.	UNITS	TOTAL WT	VAR.
101	3	510.83	170.28	7528.	1281820.	84072.62
102	5	489.25	97.85	9381.	917919.	18261.17
103	3	6.00	2.00	3822.	7644.	3.06
104	3	137.25	45.75	6022.	275520.	5644.19
106	2	69.18	34.59	3011.	104156.	1973.17
107	5	4.26	0.85	2085.	1776.	0.52
108	5	3.77	0.75	10655.	8034.	0.63
109	5	42.00	8.40	6138.	51560.	235.92
	MEAN	WEIGHT			MEAN	AVERAGE
		UPPER	LOWER		UPPER	LOWER
	2648424.	7131690.	-1834842.		54.45	146.62
						-37.72

Table 2i.

SHAMDOK 36 1978 FORTUNE BAY

COD

STRATUM	NO. SETS	NUMBER	SET/AV.	UNITS	TOTAL NO	VAR.
101	3	243.00	81.00	7528.	609757.	4459.00
102	5	106.00	21.20	9381.	198875.	920.70
103	3	12.00	4.00	3822.	15287.	19.00
104	3	10.00	3.33	6022.	20074.	10.33
106	2	88.00	44.00	3011.	132490.	3042.00
107	5	26.00	5.20	2085.	10840.	17.20
108	5	112.00	22.40	10655.	238668.	947.30
109	5	72.31	14.46	6138.	88766.	313.41

MEAN	NUMBER UPPER	LOWER	MEAN	AVERAGE UPPER	LOWER
1314757.	2288969.	340545.	27.03	47.06	7.00

Table 2j.

SHAMDOK 36 1978 FORTUNE BAY

COD

STRATUM	NO. SETS	WEIGHT	SET/AV.	UNITS	TOTAL WT	VAR.
101	3	292.75	97.58	7528.	734594.	7222.14
102	5	124.75	24.95	9381.	234053.	1398.48
103	3	12.00	4.00	3822.	15287.	20.69
104	3	15.00	5.00	6022.	30111.	19.31
106	2	103.74	51.87	3011.	156188.	4395.47
107	5	40.00	8.00	2085.	16677.	36.13
108	5	104.65	20.93	10655.	223005.	821.29
109	5	82.81	16.56	6138.	101656.	598.32

MEAN	WEIGHT UPPER	LOWER	MEAN	AVERAGE UPPER	LOWER
1511572.	2750317.	272827.	31.08	56.54	5.61

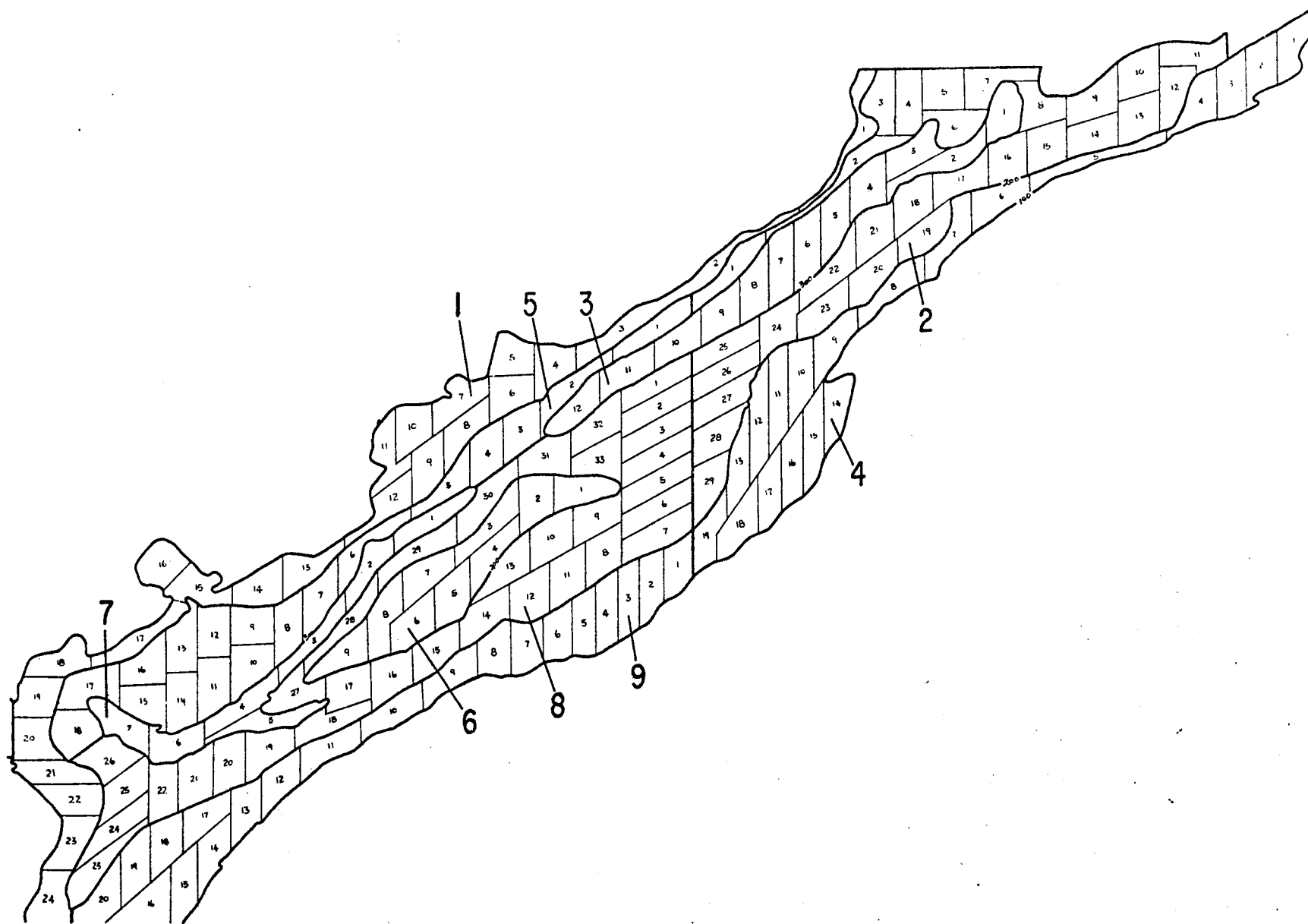


Fig. 1. Stratification design for Fortune Bay groundfish surveys between 100-400 meters.

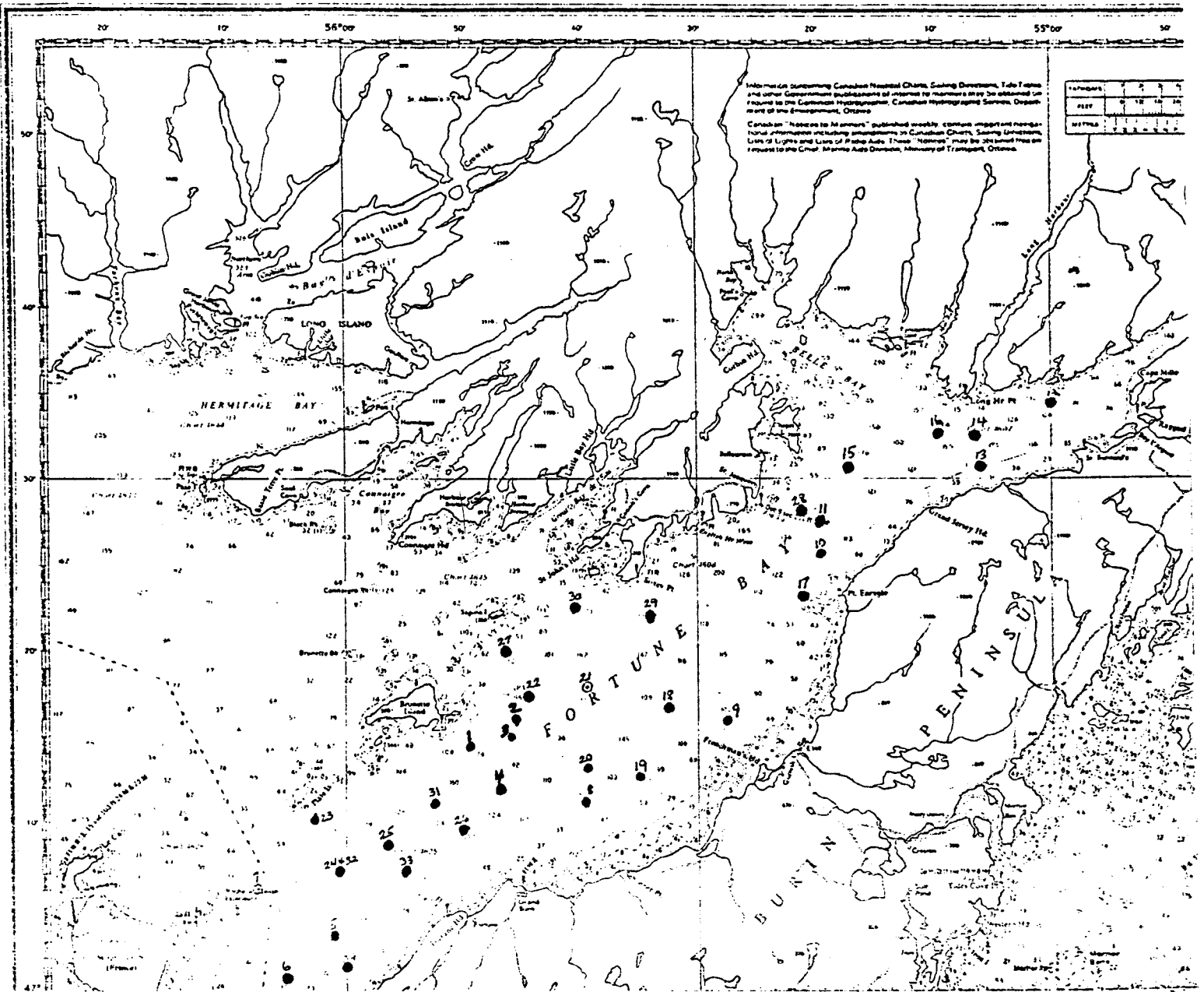


Fig. 2. Set positions of Research ship M.V. Shamook during the first stratified random groundfish survey in 1979.