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Estimation of the Recreational Cod Catch, in Numbers, in the Waters off
the Northeastern United States

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INFORMATION

Under the Fishery Conservation and Management Act (1976) management plans have been developed for cod in the waters off the Northeastern coast of the United States. The optimum yields as determined by the New England Regional Fishery Management Council (NERFMC) have had as one of their bases the assessment of the effects of fishing on the stock. The assessment work has been performed by the Northeast Fisheries Center. The procedure used in these assessments requires the estimation of removals from the fisheries. Commercial data for cod in the Northeast has been available through a system of vessel interviews and sales slips called weighouts, which are collected from fish dealers. For recreational cod fisheries, however, no such data exist. However, there have been four general surveys of recreational fishermen in years 1960-65-70 and 1974. These surveys attempted to elucidate the amount of cod taken as part of an overall survey of recreational fishing. This paper utilizes these surveys to obtain estimates of numbers removed in the recreational fishery throughout this period, for input into assessment models.

DATA BASE

Since 1960 the Bureau of Sport Fisheries and Wildlife (BSFW), U.S. Department of the Interior, has requested that the U.S. Bureau of the Census make a national survey of fishing and hunting every five years. In 1970 federal responsibility for marine sport fisheries was transferred to the National Marine Fisheries Service (NMFS). Surveys of recreational fishermen throughout the United States were conducted in 1960, 1965, and 1970. The results of these surveys have been published in various documents (Clark, 1962, Deuel and Clark, 1968, Deuel, 1973). These surveys were done nationally on a mail survey basis, which required that participants re-call the year's fishing activities. In 1974 a survey was done for the Northeast area only and relied on telephone interviews done on a mothly basis (Deuel, personal communication). In both of these methods fishermen were asked to report on the number and pounds of

fish caught. The three early surveys reported fish by the New England and Middle Atlantic regions. The 1974 survey reported fish caught by state.

From the assessment standpoint cod are treated as two stocks; Georges Bank and Gulf of Maine, therefore, it is necessary to assign catches in the recreational survey to their respective stocks (Serchuk et. al. 1978). Based on general information obtained from participants in the fishery over time it was decided to consider that the entire Georges Bank stock catch consisted of all New York, New Jersey and Rhode Island, and one half of the Massachusetts catch. The Gulf of Maine stock catch considered to be all of Maine, New Hampshire, and the remaining half of Massachusetts. The ratios obtained for 1974 were applied to the 1960-65-1970 data. The Georges Bank stock catch was 0.813 of the total, on the basis of weight, and 0.749 on the basis of numbers (Table 1).

The catches in the non-survey years were determined by applying the ratio of U.S. commercial catch to recreational catch for the years immediately adjacent to the survey years. That is for 1961 and 1962 the ratio for 1960 was used; for 1963, 1964, 1966, and 1967, the 1965 ratio was used; for 1968, 1969, 1971, and 1972, the ratio for 1970 was used; and for 1973, 1975-1978, the ratio for 1974 was used (Table 1). This is essentially the procedure described in Serchuk, et. al. (1977, 1978 and 1979).

METHODS AND RESULTS

Two techniques were utilized to estimate total numbers in the recreational catches. The first estimated total weight from the weight ratio of recreational to commercial catches and then divided the estimated weight in the recreational catch by the mean weight in the recreational fishery. The mean weight in the recreational fishery in each year of the survey was determined by dividing the reported catch in weight by the reported catch in numbers and expanding to adjacent years as described in the previous section. These results are presented in Tables 2A and 2B.

In the second method it was assumed that the number of fish caught was probably more accurately reported than the reported weight. Furthermore, it was assumed based on observations aboard recreational fishing vessels and conversations with individuals in the recreational fishery that small cod particularly 1 and 2 year olds, which frequently enter the commercial catch do not significantly enter the recreational catch. This is particularly true in the Georges Bank stock and less so in the Gulf of Maine where there is some small boat and shore fisheries for cod. Therefore, it was considered that the preferred ratio for estimating recreational catch would be the recreational catch in numbers, to the U.S. commercial catch in numbers of three years and older fish. In this procedure the catch in numbers was estimated by applying the ratio for 1960, 65, 70, and 1974 to the same adjacent years as described above thus estimating the numbers directly. This technique could not be utilized for the Gulf of Maine area because no catch at age distribution estimates are available.

Results of this estimate are given in Table 3. A comparison of results of techniques 1 and 2 are presented in Table 4. Comparison of the techniques indicate that using number ratios rather than mean weight produces larger estimates on the average. This effect may be due to the increased weight given entering year-classes in the former procedure. Catch at age distribution for Georges Bank is presented in Table 5. Distribution is based upon the yearly percentage catch at age data adjusted to threes and older in the commercial fishery as presented by Serchuk et. al. (1977) and more recent data in the files of the Northeast Fisheries Center, NMFS, Woods Hole, MA.

DISCUSSION

The numbers in the recreational catch estimated by both of these methods are quite similar (Table 4). The consideration here is that directly estimated numbers are probably the most accurate method of estimating catch. It can

then be seen that over the time period covered in the surveys, there have been shifts in the different commercial and recreational fisheries. The most noticeable anomaly being the failure of the recreational fishery on the Georges Bank stock to boom as the commercial fishery did with the entrance of the 1975 year-class in 1977. This was probably due to the two year old fish either not being vulnerable to the gear used or their in-availability in the area fished by recreational fishermen.,

Interpretation of these estimates should be done with some caution, realizing that certain year to year variations may not be picked up and that the data is only adequate to indicate trends. It should also be noted that the 1974 survey was done using a different procedure than the three earlier surveys and is thus not directly comparable. This survey did however, contact fishermen directly throughout the year on a monthly basis and thus it should be considered a more accurate survey as it relied less on memory. In 1979 a complete recreational survey, involving both telephone contacts and dock side interviews, was initiated (Pileggi and Thompson, 1979). In the future, after several years of this survey it may be possible to verify the assumptions made here concerning distribution of the Gulf of Maine and Georges Bank stocks recreational catch, and the relationship between this fishery and commercial fishing mortality rates. Data reported here should then be reviewed with the hope of improving the historical data base.

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Table 1. Estimation of recreation cod catches.

1960 Angler Survey = 4,791,000 fish
 1965 Angler Survey = 5,032,000 fish
 1970 Angler Survey = 3,844,000 fish
 1974 Angler Survey = 2,901,000 fish

1974 Gulf of Maine Stock: Me., N.H., $\frac{1}{2}$ Ma. = 728,000 fish
 1974 Georges Bank Stock: R.I., N.Y., N.J., $\frac{1}{2}$ Ma. = 2,173,000 fish

For 1974: Ratio of Georges Bank Stock Recreational Catches/Total
 Recreational = 0.749 based on numbers

Hence, 1960 Georges Bank Stock Recreational Catch =
 4,791,000 x 0.749 or 3,589,000 fish
 1965 Georges Bank Stock Recreational Catch =
 5,032,000 x 0.749 or 3,769,000 fish
 1970 Georges Bank Stock Recreational Catch =
 3,844,000 x 0.749 or 2,879,000 fish

Estimates of Redreational Catch for Years Between Recreational Surveys:

e.g. 1973 - 1976 Georges Bank Recreational Estimates

1974: U.S. Commercial catch = 4,678,000 fish; Recreational catch = 2,173,000 fish
 Ratio + 0.465

1973: ¹ 3,068,000 x 0.465 = 1,427,000 fish in Recreational Catch
 1975: 4,376,000 x 0.465 = 2,035,000 fish in Recreational Catch
 1976: 3,544,000 x 0.465 = 1,648,000 fish in Recreational Catch

1960 Survey used for estimating 1961 and 1962
 1965 Survey used for estimating 1963, 1964, 1966, and 1967
 1970 Survey used for estimating 1968, 1969, 1971, 1972
 1974 Survey used for estimating 1973, 1975, 1976, 1977, and 1978

¹Lab. Ref. 77-24, Serchuk, Frederick M. et. al.

TABLE 2. Number of fish in the recreational cod fishery as estimated by mean size in the catch. (Technique I: see text)

A. Georges Bank Stock

Year	Weight of Catch (Metric tons)	Numbrg of fish (000's)	Mean Weight (Kgs.)
1960	11395	3589	3.18
1965	11029	3769	2.93
1970	13246	2879	4.60
1974	10055	2173	4.63
			$\bar{x} = 3.84$
1961	¹ 14956	4703	
62	17795	5596	
63	15388	5252	
64	12836	4381	
1966	9607	3279	$\frac{\text{weight of catch (M.T.'s)}}{\text{number of fish (000's)}} = \text{Mean Weight(Kgs.)}$
67	14782	5045	
68	12227	2658	
69	14444	3140	
1971	12659	2752	
72	11068	2406	
73	6607	1428	
1975	9422	2036	
76	7630	1649	
77	12080	2611	
78			

¹ from Table 1 Lab. Ref. 77-24, Serchuk, Fredrick M. et. al. & Serchuk: un-published data

TABLE 2. Number of fish in the recreational cod fishery as estimated by mean size in the catch. (Technique I: see text)

B. Gulf of Maine Stock

Year	Weight of Catch (Metric tons)	Number of fish (000's)	Mean Weight (Kgs.)
1960	2621	1202	2.18
1965	2537	1263	2.01
1970	3047	965	3.16
1974	2313	728	3.18
1961	¹ 2444	1121	
62	2272	1042	
63	1741	866	
64	2165	1077	
			$\frac{\text{Weight of catch (M.T.'s)}}{\text{Number of fish (000's)}} = \text{Mean Weight (Kgs.)}$
1966	2689	1338	
67	3809	1895	
68	2480	785	
69	3181	1007	
1971	2878	911	
72	2643	836	
73	1839	578	
1975	2698	848	
76	3082	969	
77	3765	1184	
78	3709	1166	

¹ from Table 2 Lab. Ref. 77-24, Serchuk, Fredrick M. et. al. & Serchuk: un-published data

TABLE 3. Recreational Catch Estimates (Technique II see text)
Georges Bank Stock

Year	¹ Commercial (c) (Age 3 yrs. & older)	Recreational (R)	Ratio (R/C)
1960	2787	3589	1.288
1965	2593	3769	1.454
1970	4101	2879	0.702
1974	4678	2173	0.465
1961	3646	4695	1.288
62	4338	5586	1.288
1963	3612	5250	1.454
64	3013	4380	1.454
66	2255	3278	1.454
67	3470	5044	1.454
1968	3787	2659	0.702
69	4473	3140	0.702
71	3920	2752	0.702
72	3428	2406	0.702
1973	3068	1425	0.465
75	4376	2033	0.465
76	3544	1646	0.465
77	5611	2606	0.465
78			

$$\frac{\text{Total Comm } 3^+ \text{ (\#)}}{\text{Total Comm catch (wts.)}} = \frac{\text{US Comm \# } 3^+}{\text{US Com catch (wts.)}} \quad (X)$$

¹ From Serchuk, Fredrick M. et. al. 1977, Serchuk, Fredrick M. et. al. 1979 and Serchuk, Fredrick M. un-published data.

TABLE 4. Estimated recreational catches (000's of fish)

Georges Bank Stock.			
	Technique I	Technique II	Tech. II-Tech. I
1960*	3589	3589	0
61	4703	4695	-8
62	5596	5586	-10
63	5252	5250	0
64	4381	4380	-1
1965*	3769	3769	0
66	3279	3279	-1
67	5045	5044	-1
68	2658	2659	+1
69	3140	3140	0
1970*	2879	2879	0
71	2752	2752	0
72	2406	2406	0
73	1427	1425	-2
1974*	2173	2173	0
75	2035	2033	-2
76	1648	1646	-2
77	2609	2606	-3
78			
			$\Sigma = -29$

*Survey Years

TABLE 5. Georges Bank Stock Recreational catch at age (000's of fish)

Catch distribution derived from Table 3 Lab. Ref. 77-24, Serchuk Fredrick M. et. al. & Serchuk, Fredrick M. un-published data.

Year-class	YEAR																		
	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1949	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51	12	8	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
52	21	21	4	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53	45	38	18	28	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
54	182	66	36	65	25	9	-	-	-	-	-	-	-	-	-	-	-	-	-
55	331	182	69	112	55	19	15	-	-	-	-	-	-	-	-	-	-	-	-
56	1031	292	221	154	103	37	65	3	-	-	-	-	-	-	-	-	-	-	-
57	1965	949	364	358	156	85	144	29	1	-	-	-	-	-	-	-	-	-	-
58		3140	1235	553	370	125	238	54	14	4	-	-	-	-	-	-	-	-	-
59			3638	1396	522	291	270	129	26	13	3	-	-	-	-	-	-	-	-
60				2578	1185	381	359	165	47	24	11	1	-	-	-	-	-	-	-
61					1959	879	436	292	62	45	24	15	2	-	-	-	-	-	-
62						1943	679	452	140	60	38	34	10	2	-	-	-	-	-
63							1072	1154	199	138	58	57	23	6	5	-	-	-	-
64								2781	606	184	148	96	44	12	13	1	-	-	-
65									1565	657	243	235	66	18	25	4	1	-	-
66										2014	827	316	156	25	38	13	5	6	-
67											1528	776	222	64	44	19	8	8	-
68												1222	613	91	83	34	24	20	-
69													1269	257	113	109	44	34	-
70														951	365	180	145	42	-
71															1487	600	200	81	-
72																1073	405	126	-
73																	815	409	-
74																		1880	-
75																			
76																			
77																			
Totals	3589	4695	5586	5250	4380	3769	3278	5044	2659	3140	2879	2752	2406	1425	2173	2033	1646	2606	